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EXPERIMENTAL PRODUCTION OF PSEUDOCYSTS OF THE PANCREAS WITH PRELIMINARY OBSERVATIONS ON INTERNAL DRAINAGE

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PSEUDOCYSTS OF THE PANCREAS present problems of management about which there is wide divergence of opinion. Much of the disagreement stems from the rarity of this disease and the limited number of cases available for study. However, it is generally agreed that most such cases require surgical intervention and that total excision is the treatment of choice for the freely movable cyst. Unfortunately most of these lesions are large and densely adherent to adjacent structures and such a procedure is extremely hazardous. For this reason, some form of drainage is considered advisable in the surgical care of these patients. This may be carried out by utilizing external drainage with suction, by marsupialization, or by using internal drainage through a hollow viscus.

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An extensive review of the literature concerning this problem has revealed that there is no uniformity of opinion as to the role and feasibility of internal drainage procedures in the management of these cysts (2). Likewise, there is considerable debate as to the most beneficial type of cystovisceral anastomosis to be utilized. The postoperative course is often prolonged and difficult, and many cases are lost before satisfactory evaluation can be carried out. Certain studies, such as a gastrointestinal series, which might be carried out in the early postoperative period to ascertain the adequacy of the drainage procedure, are rarely performed because of the possibility of prejudicing the patient's chance for recovery.

In view of the inherent difficulties in clinical study of this disease, an investigation using experimentally produced pseudocysts of the pancreas was undertaken. In developing an experimental procedure which would produce pseudocysts of the pancreas, two principal requirements seemed necessary: (1) the creation of a cyst

FIG. 1. Photograph of a sponge-filled polyethylene bag prior to insertion within the abdomen.

wall composed of fibrous tissue without an epithelial lining; and (2) cyst fluid containing active pancreatic enzymes. A further step in this study has been concerned with evaluation of internal drainage techniques.

Previous investigators have had little success in producing pseudocysts of the pancreas and no reliable method has been reported. Thirolaix, and later Lazarus, attempted to produce cysts by injecting foreign material into the pancreatic ducts to block the external excretion of pancreatic enzymes and by crushing the pancreas to allow drainage to the outside (3). Small lesions simulating pseudocysts occasionally resulted, but these were unsuitable from the standpoint of experimental evaluation of drainage techniques because of their size and variance in position.

METHODS

The operative procedures were performed on adult mongrel dogs weighing 15 to 35 pounds with the use of intravenous nembutal (12 mgm./lb.) for anesthesia. The dogs were fed only the standard kennel ration except for periods in their postoperative course when special fluid and diet therapy was necessary.

All attempts to produce pseudocysts included the principle of diversion of pancreatic juice into a preformed space. This was necessary because of the incomplete and porous nature of the tissues encompassing the lesser omental bursa. In the first dogs, an attempt was made to utilize only the distal pancreatic ducts to more nearly duplicate the condition as seen in man. In some, the pancreas was divided at the junction of the body and tail, and both ends were placed within the cystic space. In others, either the proximal or distal ends were utilized as a single source of enzymes. In several animals, ligation of the major pancreatic duct was carried out along with these procedures in an effort to increase the flow into the sac. Attempts were unsuccessful in some animals because of an obliteration of the sac with a fibrous mass and thus failure to form a cyst. It became apparent that failure to form cysts in other cases was due to leakage of pancreatic juice into the peritoneal cavity, and a method was devised to give a watertight closure of the preformed sac and, at the same time, insure adequate flow of pancreatic juice into the space. The following staged procedure was adopted which has proved reasonably satisfactory.

First stage. The initial step was the placement of a polyethylene bag filled with gauze sponges into the lesser omental bursa (Fig. 1). Just prior to positioning, the bag was sprayed with a standard laboratory prep solution[1] to stimulate an inflammatory response with outpouring of fluid which would collect in a short period of time and become encompassed by a fibrous sac. The anterior aspect of the bag was then sutured to the posterior gastric wall to insure proper position (Fig. 2). The omentum and falsiform

[1]Solution consisted of isopropyl alchohol (95 per cent), 525 cubic centimeters; acetone, 100 cubic centimeters; tricresol, 5 cubic centimeters; mercuric bichloride, 0.7 gram; and water, 375 cubic centimeters per 1,000 cubic centimeters.

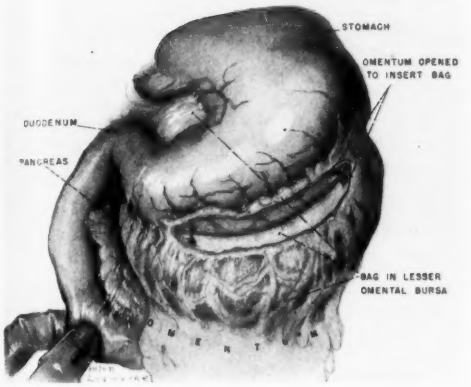

FIG. 2. Drawing of the bag in the lesser omental bursa. It has been sutured to the posterior gastric wall.

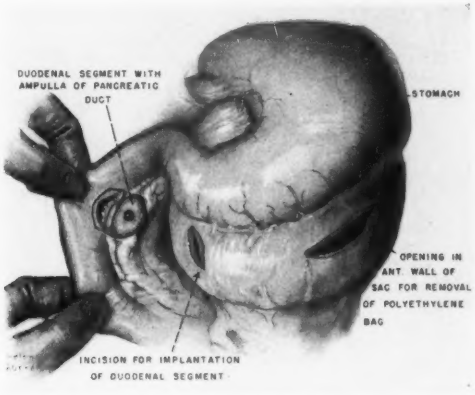
DUODENAL SEGMENT WITH AMPULLA OF PANCREATIC DUCT
STOMACH
OPENING IN ANT. WALL OF SAC FOR REMOVAL OF POLYETHYLENE BAG
INCISION FOR IMPLANTATION OF DUODENAL SEGMENT

FIG. 3. Drawing of excised duodenal segment with pancreatic duct ready for anastomosis to the sac wall.

ligament were utilized to cover the bag. The wound was carefully closed with interrupted silk sutures to minimize wound complications incident to repeated laparotomies.

Second stage. A second operation, to divert active pancreatic enzymes into the fibrous sac, was carried out 4 to 6 weeks later. The polyethylene bag was removed through an anterior incision and the character of the sac wall evaluated. If satisfactory, a 2 centimeter ellipse of the duodenal wall surrounding the major pancreatic duct was excised taking care not to cut across the intramural portion of the duct along the anterior wall of the duodenum (Fig. 3). Considerable gentleness was required to prevent trauma to the ampulla and to avoid injury to the pancreatic duct. This segment of the duodenum was then anastomosed to a 2 centimeter opening in the right posterolateral wall of the sac by utilizing fine silk sutures to obtain a watertight closure. The duodenum was closed transversely with 1 layer of inverting mattress silk sutures. The opening in the anterior wall of the sac was usually closed with catgut sutures to lessen the amount of foreign material present during the period of drainage (Fig. 4).

Third stage. A period of 5 to 7 days was allowed for development of the cyst. Reexploration was then carried out to minimize the period of obstruction to the main pancreatic duct. The cyst fluid was aspirated and amylase content determinations were obtained. Histologic sections were taken of the cyst wall in all animals early in the investigation, but not routinely in subsequent animals. In many cases, urokon was injected into the cyst at the time of drainage and a roentgenogram was obtained. Drainage was then instituted utilizing alternately transgastric cystogastrostomy and cystojejunostomy using the Roux-Y principle. These operations were selected because of the friability of the sac wall and the resultant uncertainty in securing a watertight anastomosis. A review of clinical cases gave con-

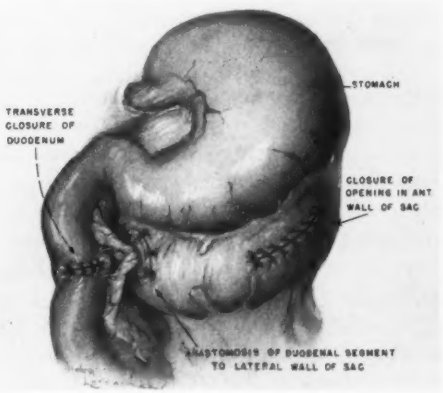
STOMACH
TRANSVERSE CLOSURE OF DUODENUM
CLOSURE OF OPENING IN ANT. WALL OF SAC
ANASTOMOSIS OF DUODENAL SEGMENT TO LATERAL WALL OF SAC

FIG. 4. Drawing of the completed second stage procedure.

FIG. 5. Roentgenographic examination of a cyst 10 days following cystojejunostomy. Urokon was injected through a polyethylene catheter which had been implanted at the time of drainage.

siderable additional evidence of the undesirability of a formal anastomosis to the cyst without diversion of the intestinal stream (2). The size of the anastomosis ranged from 1.8 to 4.8 centimeters with the majority being 3 to 4 centimeters in diameter. In several dogs, a small catheter was sutured into the cyst to allow radiographic visualization in the postoperative period and to evaluate reflux of gastric contents in those cases drained through the stomach (Fig. 5). Most of the dogs were subsequently reexplored to aid in evaluation of the healing cysts. All animals that died or were sacrificed were carefully examined postmortem to determine cause of death, status of the pancreas, presence or absence of a cyst, patency of the pancreatic duct, patency of the cystovisceral anastomosis, and the presence of changes in the stomach or jejunum.

RESULTS

Early in this investigation, 20 dogs were prepared in which the principle of excising a segment of duodenal wall with the pancreatic duct was not carried out. Small cysts were formed in only 2 of these animals; consequently no detailed analysis of these animals will be presented. The duodenal button technique was carried out on 46 dogs. The results are summarized in the following.

First stage. Of the 46 animals in which polyethylene bags were implanted, 14 died (a mortality of 30 per cent). The principal causes of death were pulmonary disease and cachexia with both often found in the same animal. Drinker has shown that limitation of diaphragmatic movement can produce acute hemorrhagic infiltration to the lower lobes of the dog. This was true in 2 of our dogs with early postoperative deaths. Other pulmonary deaths occurred in the first few postoperative days chiefly from pneumonitis and atelectasis. It is likely that these complications were due primarily to the space-filling mass within the abdomen (Fig. 6) and not to the purulent reaction elicited by the bag. In an effort to obtain better tolerance to this procedure, the animals were allowed to remain in the kennels for approximately 4 to 6 weeks. The high incidence of pulmonary infection was thus reduced. The last 10 dogs in the series were given this advantage, and there was but 1 death and that from cachexia 10 weeks postoperatively.

There were 3 animals with either inadequate tissue reaction or unsatisfactory position of the bag. Sixty-three per cent of the animals, therefore, were found suitable for implantation of the pancreatic duct.

Second stage. Duct implantation was carried out in 29 dogs; 11 deaths occurred. Eight animals died with generalized peritonitis. Even though a watertight anastomosis was obtained at operation, in these instances the suture line disrupted and the cyst contents drained into the peritoneal cavity. There was also marked intra-abdominal hemorrhage in 2 of these animals. One of these died suddenly on the seventh day, just

prior to re-exploration, presumably from acute rupture of the cyst. Fat necrosis was present in most animals and was occasionally severe. In 2 other dogs with intact cysts, there was generalized peritonitis presumably resulting from spillage of purulent fluid at the time of removal of the polyethylene bag or from an early leak of pancreatic juice which later sealed. The tenth death occurred the day of operation in a severely emaciated animal without other apparent cause.

A striking finding in this group was the high percentage of cases which satisfactorily filled with fluid following the duct implantation. All but 2 of the 19 surviving animals had well formed cysts. Cyst formation failed in 1 dog because of disruption of the duct anastomosis. Severe peritonitis developed and the dog was sacrificed. In another animal, cyst formation simply failed to take place, and operation revealed only a hard mass of fibrous tissue with a small amount of pus in the center. This response was found in several of the animals in which techniques other than suture anastomosis of the duodenal cuff to the cyst were used. A third animal with a 5 centimeter cyst was unsuitable for experimental purposes because of poor position of the cyst.

A second feature of note was the lethal nature of prostigmin stimulation during the immediate postoperative phase. Six of the first animals in this group were given 0.2 milligram of prostigmin the day of operation to stimulate pancreatic secretion. Four of these died of peritonitis and pancreatitis (a mortality of 66 per cent). Following discontinuance of this procedure, there were 7 deaths in 23 dogs (30 per cent mortality) and 1 of these died from causes other than peritonitis.

Third stage. Fifteen cysts were judged satisfactory for drainage. In addition, there were 2 cysts from the first group of 20 animals which were drained. The average diameter of these cysts was about 8 centimeters when measured after the cyst was opened. In all instances there was a marked inflammatory reaction in the surrounding tissue, and the cyst was densely adherent to the posterior gastric wall. The character of the cyst fluid, though occasionally a thin, colorless, watery liquid typical of pancreatic juice, was usually quite dark which indicated the presence of blood. The cyst wall averaged 0.3 to 0.4 centimeter in thickness with a maximal thickness of 0.8 centimeter. On histologic examination, the wall was densely fibrotic and lined with finely compressed granulation tissue. The structures were inelastic and friable. Sutures would cut through all but the thickest walls with a mild degree of tension.

FIG. 6. A gastrointestinal roentgenogram 6 weeks following bag implantation. Marked displacement and compression of the intra-abdominal contents were evident at operation.

In the early cases, the determinations for amylase contents of the cystic fluid were disappointing. Even in animals with marked fat necrosis, the level was scarcely above control values. However, it was recognized later that this was due to a modified tech-

FIG. 7. Autopsy specimen 8 weeks following cystojejunostomy. The arrow points out the open jejunal anastomosis. The patency of the ductal anastomosis was confirmed by injection of methylene blue and the passage of the probe visualized here.

nique utilizing very small amounts of starch giving a maximal amylase level of approximately 400 units. Dogs normally maintain an extremely high amylase, and there was room for but a slight increase before the range of the test was exceeded. This was corrected by greatly diluting the serum and cyst fluid, which resulted in a consistent rise in titer in the cyst fluid.

The supposition that there were active enzymes in most of the cysts produced early in this study was strengthened by the clinical findings. Ninety per cent of these animals with leakage of cystic fluid died with marked peritonitis, fat necrosis, and fluid collection. In all but 1 of the animals surviving the duct implantation, a fluid-filled cyst formed in contrast to the earlier results which were rarely satisfactory. At autopsy the ducts were explored and often were patent. In a few of those with complete obliteration of the cyst, the surgically created fistula had also closed. In no case with a persistent cyst was the duct found to be obliterated.

Of the 17 dogs undergoing drainage of a pseudocyst, 4 died (24 per cent). There were 2 deaths with each type of procedure, and 3 of the 4 dogs died the day following operation. These dogs were extremely emaciated with weight loss of 40 to 50 per cent of the preoperative body weight. The fourth animal had extensive intestinal adhesions from the 2 previous operations which made the drainage procedure difficult, and death was due to hemorrhage from an unseen tear in the splenic pedicle. In none of these animals was there failure of the procedure from a functional standpoint. There was no evidence of abscess formation, recurrent cyst, or leakage of the anastomosis.

OBSERVATIONS ON INTERNAL DRAINAGE

Thus far it is too early to draw conclusions. However, certain features of the healing process have been observed which merit consideration.

One of the difficulties in the study of clinical cases is the question of the time necessary for obliteration of the cyst. In 5 dogs, examination was carried out at periods up to 6 weeks following the drainage procedure. In none of these animals was the cyst obliterated. The dog with the smallest cyst (3.5 cm.) in the entire series was sacrificed at 6 weeks; there was no cavity but the pancreatic duct was still patent. A small cystic space was present at 11 weeks in 2 animals, the longest period with an open cyst yet observed. There was no fluid collection in either of these cysts, and the drainage sites were patent though small in size. Of the animals examined between 3 and 8 weeks following drainage, only 1 of 6 had an obliterated cyst. In 6 of the 8 dogs sacrificed after this period of time healing was complete.

An interesting, though not unexpected finding, was the rapid decrease in size of the drainage orifice, whether gastric or jejunal. In 2 instances, each re-explored 3 weeks following drainage, the anastomotic area had narrowed from 3½ and 4½ centimeters in diameter to less than 0.5 centimeter. A third animal, with a cystogastrostomy measuring 4½ centimeters in diameter was re-explored on the tenth postoperative day at which time the opening would not admit the tip of the index finger. However, in no

animal with an unobliterated space has the drainage site closed. A critical study of the relationship between the size of the drainage site and the incidence of recurrence has not yet been undertaken.

The pancreatic duct was found to be patent in all 6 dogs sacrificed with a cystic space still open (Fig. 7). However, of the 7 dogs examined after the complete obliteration of the cyst, there was but 1 with a persistent fistula. In spite of this, the pancreas was hard and fibrotic in only 2 animals, evidence of satisfactory drainage through the accessory ducts.

One of the enigmas of internal drainage procedures has been the failure to demonstrate reflux of gastric contents through cystogastrostomies. In 4 animals explored or sacrificed prior to closure of the cyst, there was no instance of the presence of food particles, or development of an abscess within the cyst. In 2 animals, polyethylene catheters were inserted into the cyst to evaluate this problem in the early postoperative period. In 1 dog, an ellipse of the stomach wall had been excised during the creation of the drainage opening. When milk was fed to this animal, it could be aspirated immediately from the cyst, and the dog appeared to have pain while eating. The second animal had simple incision through the posterior gastric wall into the cyst measuring 3½ centimeters in length. On the day following operation, the dog drank 300 cubic centimeters of milk without apparent discomfort. At this time, no milk could be obtained from the cyst. Urokon was then injected into the cyst cavity through a polyethylene catheter in the flank. This passed readily into the stomach. With the thought in mind that the injection of dye might have opened up the drainage site, another 300 cubic centimeters of milk were given. At this time, about 1 to 2 cubic centimeters of milk were obtained. Thus, in the space of an hour, on the second postoperative day, about 600 cubic centimeters of milk were fed to the dog and less than 2 cubic centimeters could be aspirated from the cyst. Following this experience, closer attention at the time of operation was devoted to the effects of a transgastric drainage incision. These wounds were found to be scarcely apparent though they were 3 to 4.5 centimeters in length. This seemed to be due to the dense fibrous tissue of the cyst wall which prevented relaxation of the edges of the gastric wound, and to prolapse of gastric mucosa into the cyst space. The latter feature is quite striking and apparently acts as a one-way valve, as in no case has there been a failure of drainage.

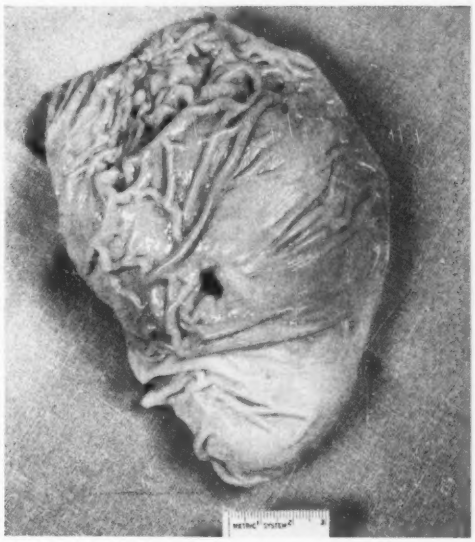

FIG. 8. Photograph of the stomach demonstrating persistent ulcer 15 weeks postoperatively. The cyst was entirely obliterated.

The persistence of a gastric ulcer has been said to be one of the dangers associated with cystogastrostomy. Five animals were sacrificed after complete obliteration of the cyst and in 2, the ulcer was healed 6 and 12 weeks after drainage. In 3 others, there was a persistent defect, not covered with mucosa, ranging from 12 to 16 weeks after drainage. In 1 case, this ulcer was found to be 1 centimeter in diameter and 1 centimeter in depth at an interval of 15 weeks (Fig. 8). Of course, the factor which is not known is the interval between closure of the cyst and examination of the animal.

The use of the defunctionalized loop of jejunum has not been associated with complications or abnormalities related to the cyst or intestine. In 1 animal there was a fatal postoperative hemorrhage from a tear in the splenic pedicle. This presumably occurred during dissection of the small bowel which was involved with dense adhesions.

SUMMARY

Experimental procedures to produce pseudocysts of the pancreas were carried out on dogs, and preliminary observations were made on internal drainage techniques in the treatment of these cysts. Results obtained in experiments on the first 20 animals in this investigation were unsatisfactory and the following method was adopted: (1) A large polyethylene bag filled with gauze sponges sprayed with a solution to induce an inflammatory response was inserted in the lesser omental bursa. The resulting reaction was the formation of a thick fibrous wall lined with granulation tissue. (2) Six to 8 weeks later, the bag was removed, and the ampulla of the major pancreatic duct, along with a surrounding segment of duodenal wall, was excised and sutured to an opening in the wall of the cavity. (3) After an interval of 5 to 7 days, the area was inspected and if a satisfactory cyst had formed, drainage was instituted using alternately cystogastrostomy and cystojejunostomy.

Fourteen of 46 dogs undergoing the first stage died principally from pulmonary disease and cachexia, and 3 of the surviving animals were considered unsuitable for the pancreatic duct implantation. Duct implantation was carried out, however, in 29 dogs. There were 11 deaths chiefly from peritonitis resulting from a break-through in the anastomotic suture line and drainage of the cyst contents into the abdominal cavity. In 2 animals cysts failed to form and drainage was not carried out on a third animal because of the poor position of the cyst. Seventeen dogs, including 2 in the first group, underwent drainage of the cyst with but 4 deaths.

Histologic sections of the cyst wall confirmed the pathologic diagnosis of pseudocyst of the pancreas. The extremely friable wall accounted for instances of anastomotic failure resulting in peritonitis, the principal cause of death. The appearance of the cyst fluid varied but the amylase content determinations verified the presence of active pancreatic enzymes in the cyst cavity.

Even the smallest of the cysts required several weeks to heal completely, and others remained open for as long as 11 weeks. In the first 10 days, the size of the drainage site was found to decrease as much as 75 to 80 per cent regardless of the type of internal drainage used. There was no instance of closure of the drainage orifice prior to obliteration of the cyst.

Gastric contents were found in the cyst when cystogastrostomy was performed by excision of an ellipse of tissue. There was virtually no reflux, however, when drainage was established by simple incision through the posterior gastric wall into the cyst. Close approximation of the wound edges and prolapse of the gastric mucosa through the drainage site appeared to be the significant factors in the prevention of reflux. Gastric ulceration, which was found in 3 of 4 animals examined 12 weeks after cystogastrostomy was carried out, is a potential source of complication in utilizing drainage through the stomach.

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MANAGEMENT OF RENAL TRAUMA

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THE KIDNEYS, situated as they are behind the protective shield of the lower ribs and the musculature of the trunk and abdomen, are not often subjected to serious injury. Nevertheless renal trauma, even in a civilian practice, is not uncommon and occurred in 1 case out of every 2,183 admissions to the Rhode Island Hospital during the past 7 years. In all, 50 such patients were admitted to this hospital and constitute the basis for this report.

Unlike most forms of renal disease, in trauma there seems to be considerable question about the best type of treatment that should be used in each individual case. The difficulty stems from the fact that there are two opposing schools of thought regarding proper methods of treatment. The conservative group, headed most recently by Sargent, believe that nonoperative treatment in most cases yields superior results. Others, notably Lowsley, are of the opinion that early surgical exploration both lessens mortality and morbidity, preserves renal function, and tends to prevent crippling late manifestations of renal trauma, such as chronic infection and hypertension. It was with the idea of achieving one practical policy of treatment that we decided to undertake this study.

Since there are a variety of ways in which the kidney can be injured, it is evident that any rationale of therapy must apply only to similar cases and cannot be made to include all injuries as a group. Therefore, it becomes necessary to establish a classification for renal injuries and to discuss methods of accurately diagnosing the extent of these injuries.

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CLASSIFICATION OF RENAL INJURIES

In the past most renal injuries have been classified into three groups as proposed by Sargent and Marquardt. Group I consists of contusion of the kidney with minor parenchymal fracture. Group II is represented as major parenchymal fracture including rupture of the capsule and perirenal hematoma with or without extravasation. In group III are those cases in which the kidney is shattered, there is complete loss of kidney architecture and considerable blood loss, damage to the pedicle, and urinary extravasation. A review of our own cases indicated that a more detailed classification of the damage would aid the choice of proper treatment. We accordingly grouped cases in the following manner: (This classification is in all respects essentially that proposed by J. H. Harrison in a detailed discussion of kidney trauma in 1940.)

Group I. Minor contusion of parenchyma without rupture of intrinsic capsule, with clinical signs and symptoms of hematuria and flank pain but without pyelographic distortion.

Group II. Major contusion of parenchyma usually associated with rupture of the capsule, with intrarenal and perirenal hematoma and pyelographic compression defects and pelvic clots.

Group III. Major contusion of parenchyma with injury of the drainage system causing intrarenal extravasation of urine with dissection under the capsule and into the renal parenchyma, but without extravasation outside the kidney itself (Fig. 1).

Group IV. Major contusion of parenchyma with injury to the pelvis or calyces resulting in the extravasation of urine outside the renal capsule and under Gerota's fascia. Included in this group are also those cases of shattered kidney, damage to the pedicle, and perforations resulting from bullet or knife wounds (Fig. 2).

Once a workable classification has been established, one must next consider diagnos-

FIG. 1.

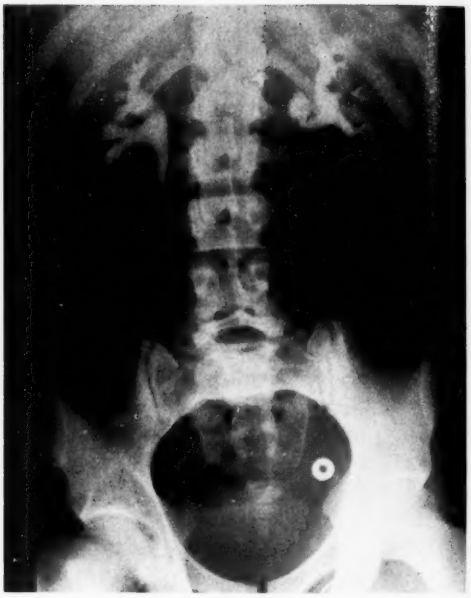

FIG. 2.

FIG. 1. Retrograde pyelogram showing intrarenal extravasation of right kidney.
FIG. 2. Excretory urogram showing extrarenal extravasation of left kidney.

tic methods which will insure the placing of each case in its proper category.

Usually the first indication of renal injury is the presence of blood in the urine and tenderness in the flank. Additional tests including blood pressure, hematocrit, and general physical examination with particular attention to any palpable mass in the flank will help one to appraise the patient's general condition and the extent of the injury. Clinical judgment is important here, particularly in the presence of shock and/or injuries to other organs.

TABLE I.—CLASSIFICATION AND CAUSE OF ACCIDENTS

Cause	*Grade*				*Total No.*
	I	*II*	*III*	*IV*	
At play—children and adults	5	6	2	1	14
Automobile accidents	4	3	3	4	14
Industrial accidents	8	0	0	0	8
Sports					
Football	5	0	0	0	5
Basketball	2	1	0	0	3
Baseball	2	1	0	0	3
At home falls	1	0	1	0	2
Gunshot wounds	0	0	0	1	1
Totals	27	11	6	6	50

An intravenous urogram can be a source of helpful information not only about the condition of the damaged kidney but also about the presence and function of the other kidney. It is definitely indicated if the patient is not in a state of shock, although one must always bear in mind that renal injuries can be more severe than one would expect judging from excretory pyelograms alone.

Considerable information is to be gained by careful clinical observation, if early surgical intervention does not seem indicated. Of particular importance are continuous blood pressure observations, urine analyses, hematocrits, and palpation to discover the presence of a mass. Hemorrhage and urinary extravasation are to be carefully watched for.

If these examinations are insufficient to make an accurate diagnosis, and if in addition the patient's general condition permits him to be moved for cystoscopic examination and retrograde pyelography, this will usually accurately assess the amount of

FIG. 3.

FIG. 4.

FIG. 3. Excretory urogram indicating injury of left kidney.
FIG. 4. Retrograde pyelogram with acorn-tip catheter of same patient as in Figure 3 showing major contusion of parenchyma with considerable intrarenal extravasation into renal parenchyma and under capsule of kidney.

damage, and should be unhesitatingly done whenever it seems indicated, as pointed out by Orkin in 1950. We have found that this procedure performed with an acorn-tip catheter inserted only into the ureteral orifice gives excellent pyelograms with minimal risk. A retrograde pyelogram when compared to an intravenous urogram will often show a strikingly graver injury than had been suspected on the basis of the latter examination (Figs. 3 and 4). It is our feeling that a general hesitancy on the part of surgeons to use diagnostic retrograde pyelography in cases of renal injury is largely responsible for the great difference of opinion regarding the proper method of treatment.

SELECTION OF CASES

Fifty cases of renal trauma were selected from patients admitted to the Rhode Island Hospital between 1947 and 1954. All of them were patients who had sustained flank or abdominal trauma, who had flank pain and tenderness associated with gross or microscopic hematuria or x-ray evidence of renal injury. The cases are consecutive, and only those in which kidney injury could not be proved were omitted.

CAUSE AND TYPE OF ACCIDENT

Approximately one-quarter of the injuries occurred to children and adults while at play, and included sledding mishaps, falling off buildings, and into wells and ditches. A similar number were the result of organized sports including football, basketball, and baseball. Industrial and automobile accidents made up the rest, or nearly one-half, and as might be expected the most serious, were those involving automobiles (Table I).

FIG. 5.

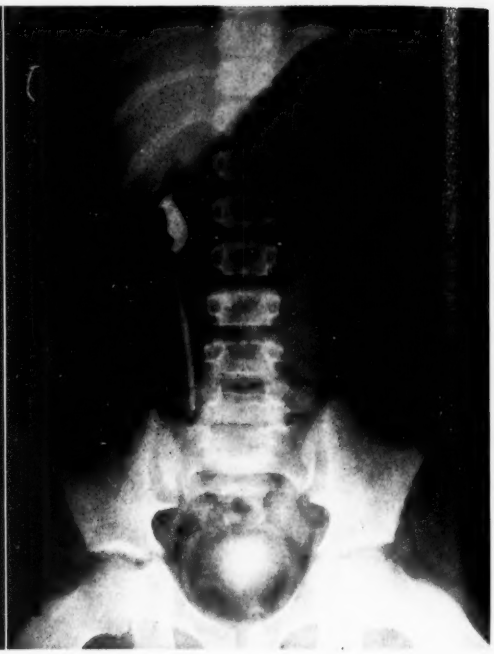

FIG. 6.

FIG. 5. Retrograde pyelogram of right kidney showing intraparenchymal fracture and extravasation of the lower pole.

FIG. 6. Retrograde pyelogram of same patient as in Figure 5 after 6 months showing small right kidney with contracted pelvis and calyces.

MORTALITY

There were 3 deaths in this group of 50 cases, and none occurred as the result of the renal injury itself. One was the result of a mesenteric thrombosis on the eighteenth hospital day in a patient whose renal injury had already healed, and the other 2 patients died as the result of compound basal skull fractures.

DIAGNOSIS AND TREATMENT OF GROUP I CASES

Twenty-seven of the 50 cases studied were thought to fall into group I. Physical findings on admission showed costovertebral angle tenderness and muscle spasm, microscopic hematuria in 11 and gross hematuria in 16 cases. Nineteen intravenous and 2 retrograde pyelograms were performed within 4 days of admission. Treatment in all cases was along conventional lines, consisting of supportive therapy and bed rest, with an average hospital stay of 8.7 days. It is our policy in general to keep patients in bed in the hospital for several days after the urine is grossly clear and for at least another week at home after discharge from the hospital. The average time until cessation of hematuria, both gross and microscopic, in this group was 3.6 days. Of interest were the concomitant injuries which occurred. There were 4 patients with severe head injuries, one of whom died of a basal skull fracture on the second hospital day, and another on the eighteenth hospital day of mesenteric thrombosis at a time when the urine had been free of blood for over a week. In addition to other miscellaneous fractures there were 4 cases of fractured ribs and 1 of a fractured transverse process of the third lumbar vertebra on the side of the kidney injury.

Follow-up study of these patients was scanty. However, of 14 cases subsequently seen in private offices or in the Out-Patient Department, all had normal or nearly normal urinary findings and were in good health. It would appear on the basis of these results, as well as the experience of others, that conservative management of patients in this group is the treatment of choice.

DIAGNOSIS AND TREATMENT OF GROUP II CASES

There were 11 cases which fell into this category, which consists of more severe kidney injury associated with pyelographic changes indicating pelvic or calyceal clots or intrarenal and perirenal hemorrhage and hematoma. All of the patients in this group had varying amounts of pain in the flank and usually flank tenderness and muscle spasm. One patient was admitted with a palpable flank mass, and in 2 patients a mass developed in the flank which on retrograde examination was found to be due to intrarenal and perirenal hemorrhage but not to extravasation of urine. All patients had grossly bloody urine or urine described as loaded with erythrocytes, and the hematuria cleared in 5 to 20 days (average 11.3 days). All patients had excretory urograms, which demonstrated the extent of damage in all but 1 case. In this individual a mass developed in the flank after a week in the hospital. Retrograde pyelograms definitely showed this to be due to a perirenal hematoma and not to extravasation of urine.

Treatment of all patients consisted of bed rest; 5 patients required the administration of blood. The hospital stay varied from 6 to 24 days (average 12.7 days). No patient required operation.

Eight of the patients were followed-up after hospital discharge and were found to be well. Six of these had normal excretory urograms and urine analyses several months after injury.

On the basis of the essentially favorable outcome of these cases, it would appear that nonoperative management with administration of blood, when necessary, is the treatment of choice. Intravenous urograms seemed to give satisfactory indication of the extent of damage in all but 1 case, and here retrograde pyelography gave the necessary information.

FIG. 7. Excretory urogram showing intrarenal extravasation in region of left renal pelvis.

DIAGNOSIS AND TREATMENT OF GROUP III CASES

This group of cases includes those patients with major renal damage who in addition have extravasation of urine and hemorrhage into the renal parenchyma, or under the renal capsule, but without extravasation outside the kidney itself. These injuries are considerably more severe than those in group II, as is indicated by the longer average hospital stay, 14 to 25 days (average 16.6 days). There were 6 patients in this group and all had flank pain, tenderness, and muscle spasm. In all, the urine was grossly bloody. Retrograde pyelograms were necessary for accurate diagnosis in 4 of these cases because of poor function on intravenous urogram. All patients were treated with bed rest but 3 of the 6 might well have been considered candidates for operative interven-

FIG. 8.

FIG. 9.

FIG. 8. Excretory urogram indicating contusion of upper pole of left kidney.
FIG. 9. Retrograde pyelogram of left kidney in same patient as in Figure 8 showing major contusion of parenchyma with extravasation of urine outside of kidney itself.

tion and their cases are discussed in detail below.

CASE 1. E. T., an 8 year old boy, was struck in the right flank while at play. On admission there was marked right flank pain and tenderness, but no mass. The blood pressure was 116/50 and the urine contained innumerable red blood cells. Intravenous urograms showed a nonfunctioning lower half of a double right kidney, the outline of which was considerably enlarged because of an extrarenal hematoma. Subsequent retrograde pyelograms demonstrated intraparenchymal extravasation into the lower pole of this kidney, indicating considerable parenchymal fracture. The patient was treated with bed rest and discharged on the sixteenth hospital day, the urine having cleared on the twelfth day. One month later intravenous pyelograms showed some function, but there was incomplete filling due to compression from renal edema and unresolved hematoma. On reexamination 6 months later the right kidney outline appeared smaller than normal, and the pelvis and calyces, although well filled, appeared contracted. This was deduced to be perirenal and intrarenal scarring as a result of the injury (Figs. 5 and 6).

CASE 2. M. T., an 18 year old girl, was forcibly pushed against a counter while playing with friends. Her left side was injured and showed tenderness and muscle spasm on admission. There was no palpable mass, the blood pressure was 120/70 and the urine was grossly bloody. Intravenous urogram showed some enlargement of the left kidney shadow, a somewhat distorted drainage system with clots, and definite intrarenal extravasation of radio-opaque material in the region of the renal pelvis (Fig. 7). The patient, who was a Christian Scientist, refused cystoscopic examination and left the hospital in 2 weeks despite persistent gross hematuria, which continued even though she remained in bed at home for 2 more weeks. The urine finally became clear at the end of 2 months and an intravenous urogram at that time showed no abnormality.

CASE 3. H. B., a 57 year old man, was severely injured in the right flank when the car he was driving was struck by another automobile. On admission to the accident room his blood pressure was 50/40, and the urine was grossly bloody and contained many clots. Thirty-five hundred cubic centimeters of blood were given in the next 6 hours before his blood pressure became stable. Emergency operation to control

hemorrhage was seriously considered but proved not necessary since there were no continuing signs of active hemorrhage. Retrograde pyelograms several days later showed definite intraparenchymal extravasation of radio-opaque material as well as intrarenal and extrarenal hematoma. The patient was treated conservatively but had a stormy convalescence complicated by severe ileus and jaundice, the latter thought to be due to concomitant liver injury. His urine became clear by the twelfth hospital day, and he was finally discharged on the twenty-seventh hospital day. One year later an excretory urogram showed diminished function on the right with evidence of scarring of the calyces.

These 3 cases seem to indicate that operative interference might have considerably shortened the hospital stay and in 2 of them the final result might have been better. The pathologic condition in these cases consists of considerable edema and contusion of the renal parenchyma, often aggravated by thrombosis of vessels and infarction of kidney tissue. In addition there are intrarenal blood clots as well as clots under the capsule, and intraparenchymal rupture of the drainage system with extravasation of urine into the parenchyma. Infection is apt to supervene, resulting in parenchymal abscess as well as infection of the infarcts. It seems reasonable to suppose that operative intervention to evacuate hematomas and any intraparenchymal collections of blood or fluid would lessen morbidity, shorten convalescence, and definitely improve end results.

DIAGNOSIS AND TREATMENT OF GROUP IV CASES

The 6 patients in this group were the most severely injured of the series. The average hospital stay was 21.3 days; all but 1 required blood transfusions, and all but 1 had extrarenal extravasation of urine, usually best demonstrated by retrograde pyelogram. Four of these patients were operated on. Of the 2 who were not so treated, one died on the third hospital day of a basal skull fracture and the other refused operation and was lost to follow-up after discharge on the eighteenth hospital day. The operative cases are instructive and their treatment is detailed in the following paragraphs.

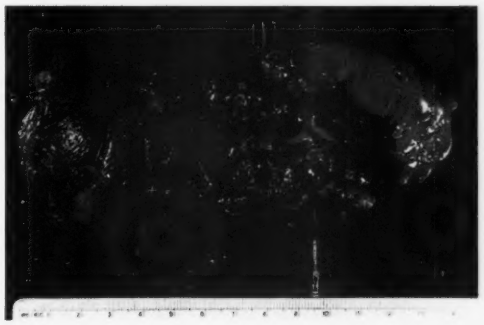

FIG. 10. Photograph of left kidney of same patient as in Figures 8 and 9 after emergency nephrectomy.

E. D., a 24 year old female, sustained an injury to her left side in an automobile accident. Intravenous urograms indicated contusion of the upper pole of the left kidney (Fig. 8), but the appearance and increasing size of a flank mass prompted re-evaluation by retrograde pyelogram on the third hospital day (Fig. 9). Emergency nephrectomy was carried out on the same day and a badly contused, bisected kidney was removed (Fig. 10). The patient made an uneventful recovery and was discharged on the ninth hospital day.

The appearance of an enlarging flank mass indicated prompt use of retrograde pyelography for more accurate diagnosis, and immediate surgery resulted in rapid recovery. In this case it did not appear that the kidney could logically be saved.

J. A., a 14 year old boy, was shot through the right side, the bullet lodging in the middle of the body of the first lumbar vertebra. There was gross hematuria but intravenous pyelograms showed a normally functioning right kidney surrounded by a large perirenal hematoma. Conservative treatment was abandoned when the patient developed progressive ileus and it was feared that he had a ruptured abdominal viscus. Exploration on the third hospital day revealed no intra-abdominal injury. A large perirenal hematoma was found, evacuated, and the wound drained. There was no evidence of urinary extravasation. The patient improved remarkably immediately after this procedure and was discharged 12 days later. Intravenous urograms after 1 year showed normal kidneys.

The unmistakably rapid improvement in this case strongly suggests that the drainage of a large perirenal hematoma does much to improve the patient's general condition, that it relieves ileus, shortens hospitalization, and may prevent scarring.

The remaining 2 patients both suffered renal laceration with extrarenal extravasation of urine. Both were treated conservatively, one for 4 weeks and the other for 2.

In the first case operation was necessary because of an enlarging flank mass and febrile course, with deterioration of the patient's general condition. At operation a huge, infected, perirenal extravasation of urine was encountered. This surrounded a markedly indurated pyonephrotic kidney. A nephrectomy was carried out, and the patient was discharged 55 days after injury. In the second case operation was carried out after 2 weeks because the patient failed to improve. An infected mass of organizing hematoma and a soft pulpified kidney were encountered and successfully removed, and the patient was discharged from the hospital 6 days later.

Both of these cases indicate that early operation in instances of proved extrarenal urinary extravasation offers the best opportunity for saving the kidney if possible; otherwise primary nephrectomy can be undertaken.

DISCUSSION AND SUMMARY

A study of 50 patients with renal trauma admitted to the Rhode Island Hospital during the past 7 years was undertaken in order to arrive, if possible, at a practical policy of treatment. The cases were classified into four groups: minor contusion, major contusion, major contusion with intrarenal extravasation, and major contusion with extravasation outside the kidney itself. Methods of diagnosis were reviewed and it was concluded that accuracy of diagnosis is essential to ideal treatment. Excretory urograms are of paramount importance to determine the presence and functioning capacity of the uninjured kidney, but often do not accurately assess the extent of damage to the injured kidney. This is particularly so in the more severely injured patients, and it is therefore concluded that cystoscopy and retrograde pyelograms made with an acorn tip catheter should be unhesitatingly carried out whenever necessary.

Of the 50 cases, 38 were classified as minor contusion or major contusion without extravasation of urine. Conservative supportive therapy appeared to give excellent immediate and long term results. There were no instances of chronic renal infection or acquired hypertension.

There were 6 cases of major contusion with intrarenal extravasation of urine, all treated conservatively. A review of these cases suggests that operative intervention in some of them would have hastened recovery and prevented intrarenal and perirenal scarring as a late complication.

The remaining 6 patients all suffered major renal injury with extravasation of urine outside the kidney. Early operative interference designed to remove a shattered kidney, or to repair and drain a less severely injured kidney seemed to be the treatment of choice. This rarely if ever need be done on an emergency basis but should in most cases be deferred until the patient's condition becomes stabilized and necessary diagnostic procedures have been carried out. There were no cases in this series in which bleeding was so severe that emergency surgery to prevent fatal hemorrhage was deemed necessary. It should be re-emphasized that in such cases preoperative determination of the presence of a functioning kidney on the uninjured side must be made even if this entails preoperative cystoscopy and retrograde pyelography.

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SIMULTANEOUS INTRAVENOUS CHOLANGIOGRAPHY AND UROGRAPHY

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DEPENDABLE, consistent, and adequate simultaneous visualization of the biliary and urinary tracts is now possible following the intravenous injection of SH 332, known as duografin. This is a combination of cholografin methylglucamine, already in use for intravenous cholangiography, and renografin, already in use for intravenous urography. It is dispensed in 20 cubic centimeter ampules, with a companion 1 cubic centimeter test ampule. The optimal dose is 40 cubic centimeters. The preparation consists of a 20 per cent solution of cholografin methylglucamine and a 40 per cent solution of renografin. Preparations with different proportions of both media are being presently investigated in our department.

The use of renografin results in exclusive visualization of the urinary tract, while the use of cholografin and cholografin methylglucamine results in visualization of the biliary tract and not infrequently—up to a maximum of 50 per cent of cases investigated—in sufficient renal excretion to produce a urogram of adequate diagnostic value. The latter occurrence, however, is quite unpredictable, hence unreliable for examination of the urinary tract.

The intravenous injection of 40 cubic centimeters of duografin results in excellent and prolonged visualization of the urinary tract and of equally satisfactory visualization of the biliary tract (Fig. 1).

In investigating duografin, during the past few months, our chief concern and objective have been: (1) to determine whether there would be a place for routine simultaneous examination of the biliary and urinary tracts, and whether it would constitute a worthwhile addition to our routine diagnostic procedures, (2) to determine and evaluate its indications and contraindications, (3) last but not least, to determine its relative safety and the incidence of side reactions.

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MATERIAL STUDIED

This report is based on the results of examination of 100 patients in our Department of Radiology. Fifty patients were referred primarily for examination of the biliary tract, 40 patients, primarily for examination of the urinary tract, and 10 patients, because of varied and indeterminate symptoms and clinical findings pointing mostly to the upper right side, anteriorly or posteriorly, or because they presented other diagnostic problems. The diagnostic value of the examination was often by exclusion.

SIDE REACTIONS

Contrary to expectations the incidence of side reactions following the use of duografin not only proved to be lower than the combined total for cholografin methylglucamine and renografin but compared favorably with the results following the use of each individually. In our experience the incidence of side reactions has been minimal and insignificant (Table I).

As is the case with intravenous cholangiography and urography, preliminary testing for sensitivity is of little or no value. Nonetheless, for the sake of complete records for medicolegal purposes, it may be wise to perform such tests. All other precautions used in conjunction with the intravenously administered contrast media should be observed in this procedure, and should be faithfully followed.

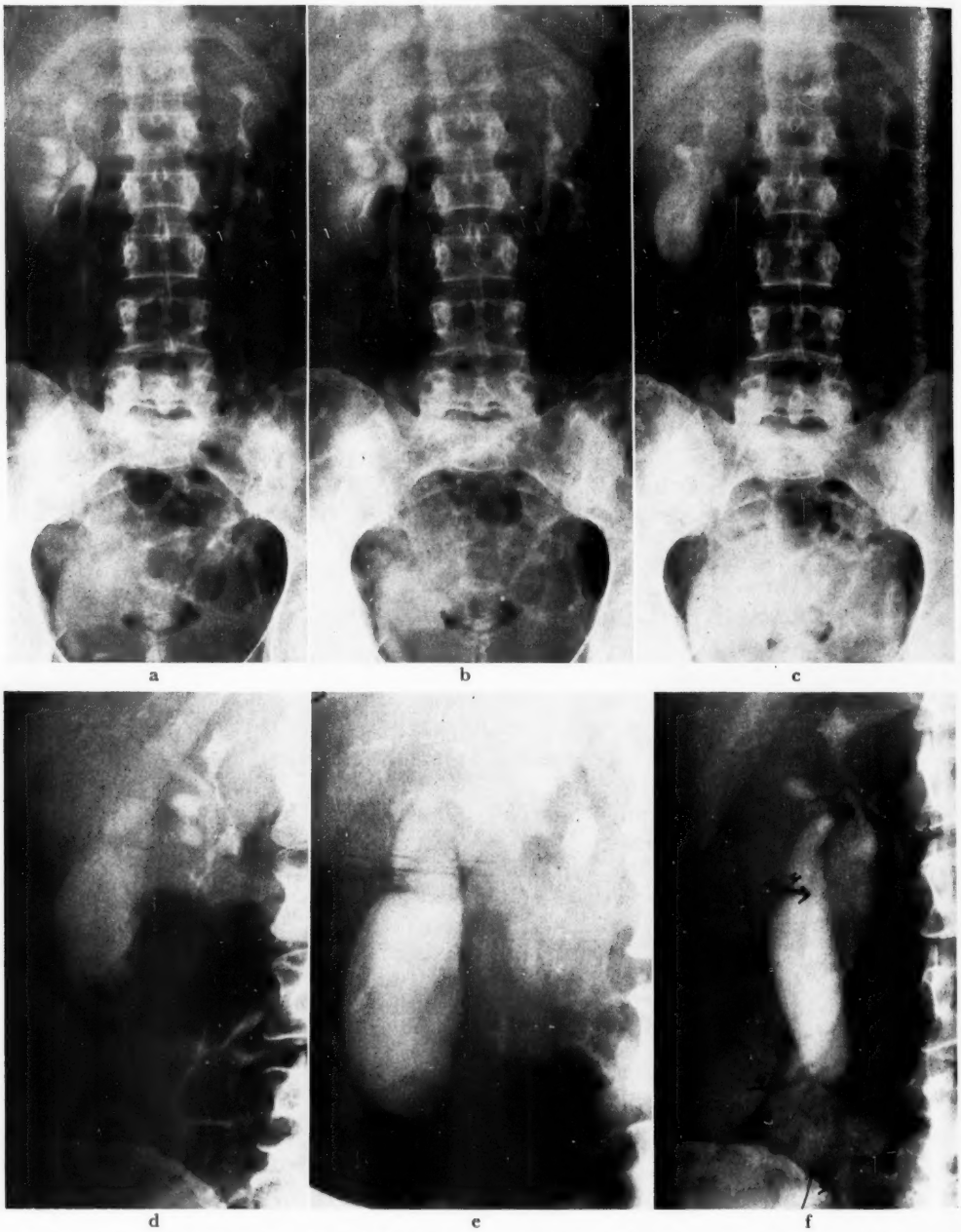

FIG. 1. Patient A. K. a, b, c, Five, 10, and 15 minutes after injection of 40 cubic centimeters of duografin. Prompt urinary tract visualization; early filling of the gallbladder; both urinary and biliary tracts are normal. d, Twenty minutes after injection; e, 50 minutes after injection—gallbladder well filled and ducts adequately visualized; f, 10 minutes after fat meal—prompt response with decreased size of gallbladder (arrow *1*); normal bile ducts (*2*); renal pelvis and calyces still opacified (*3*); contrast medium in duodenum (*4*).

TABLE I.—COMPARISON OF SIDE REACTIONS

	Cholografin methylglucamine	*Renografin*	*Duografin*
Nausea	4	6	8
Vomiting	1	0	0
Sense of heat and flushing	3	2	2
Faintness	2	1	1
Sense of choking	0	1	1
Itching	0	1	0
Pain at site of injection	0	0	0

Based on observations of 100 patients after injection of 20 c.c. of cholografin methylglucamine, 100 patients after injection of 20 c.c. of renografin, and 100 patients after injection of 40 c.c. of duografin.

PREPARATION OF THE PATIENT

This procedure is the same as for either intravenous cholangiography or urography, namely, dehydration by withholding fluids for at least 12 hours, and the administration of castor oil at bedtime. A meal containing simple fats administered the evening before will empty the gallbladder of bile and result in better filling with the contrast medium at the time of injection. In cases of emergency or in the presence of contraindications, this preparation may be omitted or modified.

TECHNIQUE

The technique consists essentially of an adaptation of the combined techniques used in intravenous urography and cholangiography.

A 14 by 17 scout film of the urinary tract is obtained with the patient in the supine position, and a 10 by 12 film of the right upper quadrant is obtained in the prone position. After completion of the injection films of the urinary tract are made at 5, 10, and 15 minutes, including a film in the upright position at 10 minutes and a post-evacuation film of the bladder at 15 minutes, examination of the urinary tract is discontinued unless there is reason for making delayed films.

Films of the biliary tract are made at 10 minute intervals up to 60 minutes. The patient remains in the supine position, the left side is elevated 15 to 30 degrees or more, if necessary, until the bile ducts are clearly and adequately demonstrated. In the cholecystectomized patient the examination is usually completed within 60 minutes, while in the noncholecystectomized patient after gallbladder visualization, the examination is concluded in accordance with the established routine procedure.

Overlapping of the biliary and right urinary tracts does not present as much diffi-

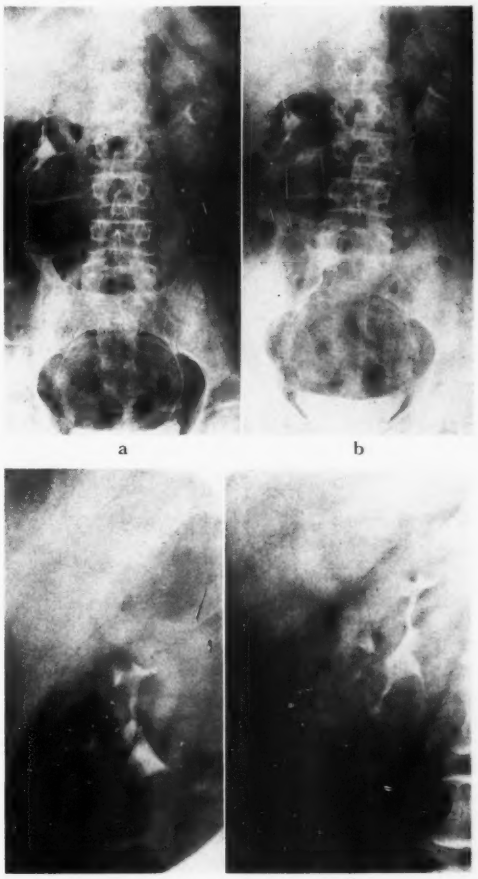

FIG. 2. Patient E. B. Cholecystectomized in 1931. Films made after injection of 40 cubic centimeters of duografin. a and b, Five and 15 minutes after injection prompt excretion and normal visualization of the entire urinary tract. c, Forty minutes after injection; slightly dilated hepatic and common bile ducts; renal pelvis and calyces still visualized, partially obscuring distal common bile duct. d, Sixty-five minutes after injection; further rotation of the patient separates the common bile duct from the renal pelvis and calyces. Note copious flow of contrast medium into the duodenum.

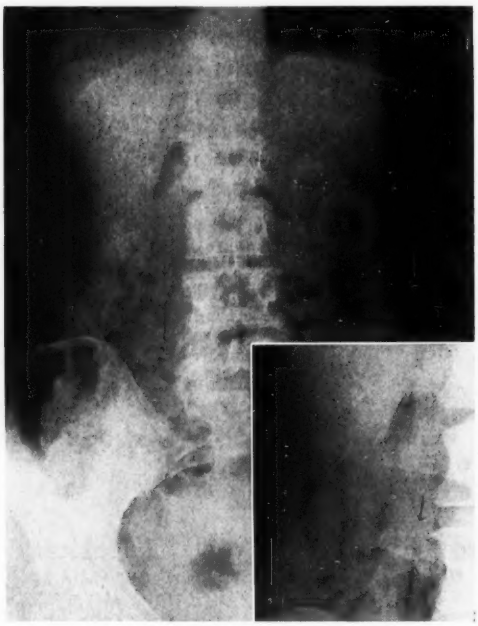

FIG. 3. Patient E. O. Fracture of right transverse process of fourth lumbar vertebra discovered on plain film of the urinary tract. This would have been missed if only films of right upper quadrant had been made; evidently the fracture was totally unsuspected on clinical examination.

FIG. 4. Patient P. C. Prompt bilateral renal excretion; incompletely bifid right renal pelvis; anterior enlargement of the prostate; faint visualization of the hepatic and common bile ducts; nonvisualization of the gallbladder.

culty as would be anticipated. It may be readily corrected or obviated by rotation of the patient (Fig. 2c and d) in varying degrees of obliquity guided by careful inspection of each film as soon as it is processed and while still wet.

Of significance has been the discovery of the following findings which, though totally unsuspected, or not looked for on the basis of clinical observations, seem to offer a satisfactory explanation of the symptoms and to present an effective guide to treatment.

1. Right-sided pyelitis and early hydronephrosis was observed in 2 cholecystectomized patients whose symptoms were attributed to so-called "postcholecystectomy syndrome" (cholecystectomy 5 and 7 years previously).

2. Appreciable mobility of the right kidney was seen in 2 cholecystectomized patients whose right-sided distress was attributed to postcholecystectomy syndrome (cholecystectomy 4 and 10 years previously).

3. By exclusion, one examination indicated a normal urinary and biliary tract. This was followed by a barium enema which revealed the presence of an annular carcinoma of the ascending colon, obviously the cause of the patient's symptoms and rightsided distress.

4. The incidental finding was made of a fracture of the right transverse process of the fourth lumbar vertebra in a 61 year old stoic white female who had been cholecystectomized 5 years before and complained of right-sided pain. The fracture was discovered on the films of the urinary tract (Fig. 3).

5. A deep-seated tumor, difficult to palpate, was discovered in the upper right side in a patient who had been carefully examined by an internist, surgeon, and urologist. Si-

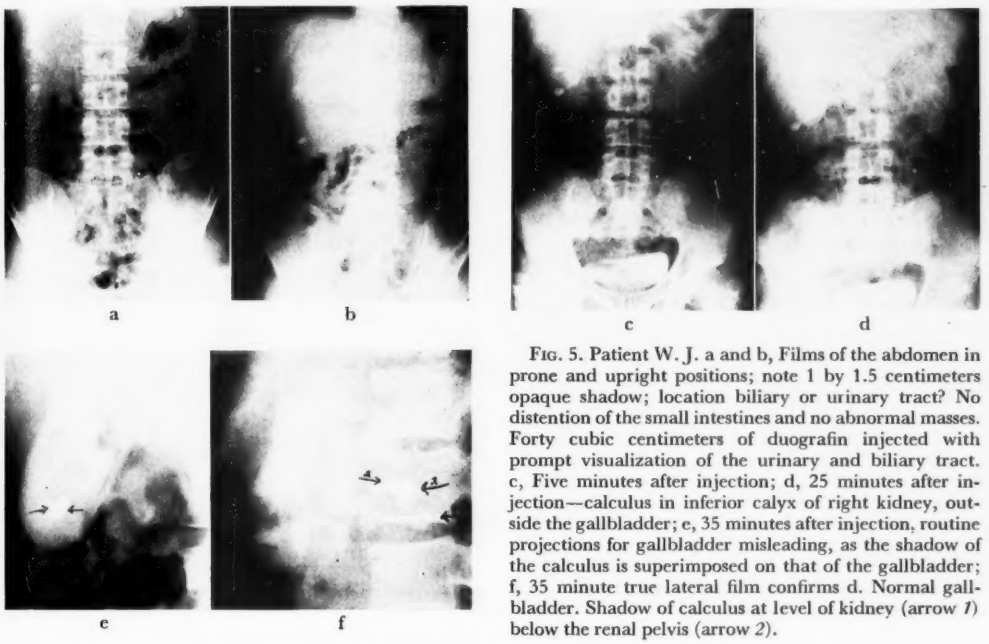

FIG. 5. Patient W. J. a and b, Films of the abdomen in prone and upright positions; note 1 by 1.5 centimeters opaque shadow; location biliary or urinary tract? No distention of the small intestines and no abnormal masses. Forty cubic centimeters of duografin injected with prompt visualization of the urinary and biliary tract. c, Five minutes after injection; d, 25 minutes after injection—calculus in inferior calyx of right kidney, outside the gallbladder; e, 35 minutes after injection, routine projections for gallbladder misleading, as the shadow of the calculus is superimposed on that of the gallbladder; f, 35 minute true lateral film confirms d. Normal gallbladder. Shadow of calculus at level of kidney (arrow *1*) below the renal pelvis (arrow *2*).

multaneous urography and cholangiography demonstrated normal bilateral renal excretion, bifid right renal pelvis, anterior enlargement of the prostate, and nonvisualization of the gallbladder (Fig. 4). These findings directed the surgical approach to the right upper quadrant, anteriorly, instead of to the right urinary tract. A deep-seated large gallbladder filled with calculi was removed.

6. The most striking case was that of W. J., a 37 year old white male, admitted to the emergency ward on January 29, 1957, complaining of acute abdominal pain, nausea, and vomiting. There was, however, no definite rigidity. The admission diagnosis was that of an acute surgical condition of the abdomen, probably intestinal obstruction. Roentgen examination of the abdomen was performed in the prone and upright position. A 1 by 1.5 centimeter well-defined opaque shadow was noted in the right upper quadrant (Fig. 5a and b). It appeared to be rather low for gallbladder, rather lateral for kidney. The metallic foreign body to the left of the fifth lumbar vertebra represented a lead shot, similar to many others in the thighs and left leg (not shown here). Simultaneous intravenous cholangiography and urography revealed a normal biliary tract and a calculus in the inferior calyx of the right kidney which was confirmed at operation (Fig. 5c, d, e, and f).

7. Less dramatic but still significant was the discovery of large uterine fibroids in 9 patients, with compression of the urinary bladder, and anterior enlargement of the prostate in 8 patients.

Otherwise, the abnormal findings in the gallbladder and the bile ducts as well as the kidneys, ureters, and urinary bladder were essentially not unlike those to be found in any cross-section of patients in a comparable series of examinations of the biliary or urinary tract.

ADVANTAGES AND DISADVANTAGES

Rapid visualization permits evaluation of two important systems of the body through one single examination, at one time. Only

one injection is needed instead of two. This circumstance is especially important and time-saving when a rapid diagnosis is needed in very sick patients or when the examination is part of a general check-up.

The examination is a time-consuming procedure, technically rather elaborate as compared with a single separate examination of either the biliary or urinary tract.

INDICATIONS AND CONTRAINDICATIONS

The procedure is indicated in those patients who require a general check-up or in whom a survey of both the biliary and urinary tracts is necessary.

It is indicated also in the differential diagnosis of ill-defined conditions of the right upper quadrant and abdomen accompanied by complaints referred to the right side anteriorly or posteriorly without definite localization and in the differential diagnosis of masses in the right side.

The contraindications for use of the method are the same as for the intravenous administration of contrast media in general.

SUMMARY AND CONCLUSIONS

We have at our disposal a safe, reliable, and useful procedure for the simultaneous roentgen examination of the biliary and urinary tracts.

Based on our present experience, simultaneous cholangiography and urography are indicated and most valuable when used in selected cases. Because of the technical factors and time element involved, it remains to be seen whether this method of examination will become a routine procedure replacing routine urography and cholangiography.

ELECTIVE CARDIAC ARREST FOR OPEN-HEART SURGERY

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ELECTIVE CARDIAC ARREST is perhaps the most significant adjunct to intracardiac surgery since the development of cross-circulation techniques. The surgeon's ability to stop—then restart—the human heart at will serves to approximate for cardiac surgery the conditions that are ideal for any operation: a surgical field that is dry, motionless, and well visualized. Moreover, cardiac arrest deliberately produced under appropriate surgical conditions is technically simple and has been applied clinically with encouraging results.

The advantages of elective cardiac arrest become apparent when one considers the handicaps imposed by the conventional bypass technique used for open-heart surgery. Occlusion of the systemic venous return to the heart permits detour of the venous blood to the pump-oxygenator, from whence it is returned in an oxygenated state to a major artery, usually one of the subclavian arteries. Actually the term "bypass of blood" is relative, since there is a significant flow via the coronary circulation to the right side of the heart; in addition there may be incompetency of the aortic valve, or a large collateral circulation to the lungs, as in tetralogy of Fallot. In such cases, for the time required to perform the intracardiac procedure, blood circulating to the bypassed heart may be measured in liters. The surgical hazards created by this constant flow and the excessive loss of blood are obvious; further, they are compounded by the constant motion of the beating heart and the persistent impairment to visualization of the surgical field.

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Lillehei and his group have employed temporary aortic occlusion by tourniquet to reduce for brief intervals the blood return via the coronary vessels. They have cautioned against injudicious uses of this method, as it may produce dangerous myocardial ischemia. Experience in our laboratory (1) has confirmed both that aortic occlusion reduces blood flow to the bypassed heart and provides excellent visualization, and that it should be used intermittently and only for short periods of time. Since the bypassed heart continues to beat, its oxygen requirement persists, and deprivation of oxygen may produce a serious metabolic deficit that is evidenced by cardiac arrhythmia and weakness of contraction that results in systemic hypotension.

Knowledge that the heart can be arrested and restarted by chemicals is not newly acquired, as the basic physiologic observation was reported in 1883 by Ringer. As early as 1929 it was suggested that the principle be clinically applied for the control of ventricular fibrillation and more recently for open-heart surgery. The major impetus to clinical application, in our opinion, has been provided by Melrose and his co-workers. This group in England developed what appears to be the simplest and most effective technique of inducing cardiac arrest and then re-establishing a satisfactory cardiac rhythm. The major advantage of the Melrose technique is the simplicity and the dependability with which it works. One drug only, potassium citrate, is needed to produce true cardiac arrest at normal body temperature. Recently methods have been described that require more than one drug with or without hypothermia.

To be acceptable to the surgeon, elective cardiac arrest must meet the following criteria: (1) The method must be simple and completely effective. (2) The heart must be made motionless and insensitive to mechanical stimuli. (3) The safe period of cardiac arrest must be sufficient to permit unhurried and meticulous surgical correction of the underlying cardiac defect. (4) The period of arrest must be amenable to prompt termination at the surgeon's will.

The Melrose technique complies with these criteria as borne out by experimental and clinical experience.

TECHNIQUE OF ELECTIVE CARDIAC ARREST

Bypass circulation and pump-oxygenator. The surgical bypass of the beating heart is performed in the now conventional manner. After the pump-oxygenator is in operation, the venae cavae are occluded by tape ligatures and the systemic return to the right auricle detours to the heart-lung preparation. The oxygenated blood is returned by cannula to the aortic arch via a subclavian artery. Prior to establishing the extracorporeal shunt, the ascending aorta is mobilized midway between the valve and the innominate artery. This isolation is easily performed. The significant collateral vessels are carefully avoided as a tape is passed around the aorta to facilitate later occlusion with a clamp.

Occlusion of aorta and injection of potassium citrate. Shortly after the bypass begins, and as the major venous return is excluded, there is significant reduction in the size of the heart. After a lapse of 1 or 2 minutes, the previously mobilized aorta is occluded with an aortic clamp; we use the angled Potts ductus or the Potts coarctation clamp. Following occlusion, potassium citrate mixture is injected into the proximal aorta (Fig. 1a), where it diffuses through the coronary vascular bed. We use 2 milliliters of a 25 per cent solution of potassium citrate mixed with 18 milliliters of heparinized blood. The amount of the mixture is variable and seems to be relative to the size of the heart and the competence of the aortic valve. In small children, 8 to 10 milliliters may be sufficient; in adults, as much as 150 milliliters of the potassium citrate-blood mixture may be necessary. Injection should be rapid and continuous until the heart stops. Cessation of ventricular heart beat usually is prompt and follows within seconds after the initial injection. The tip of the right auricular appendage is the last part of the heart to become quiescent since it is farthest from the source of coronary flow. When cardiac arrest has been established, the heart appears to become enlarged and flaccid. The site of incision in the auricle or ventricle is selected, stay sutures are placed, and the incision is made. The blood contained in the cardiac chamber is aspirated and direct inspection of the interior becomes possible.

If flow of oxygenated blood persists after the heart is opened, blood must be entering the left side of the heart through established collateral circulation, bronchial vessels, or a patent ductus arteriosus. The gentle flow of arterial blood entering from the left side of the heart via a septal defect may be a guide in judging the adequacy of the subsequent closure. If the repaired septal defect is bloodtight, the perfusion flow returns in a retrograde manner from the pulmonary artery. If, however, there is another septal defect, it will appear at that level.

Closure of septal defect. When cardiac arrest is used in operations for ventricular or auricular septal defects, the majority of hearts can be closed by direct suture (Fig. 1b); only a few will require some form of prosthesis. In our early cases the defects were closed with interrupted silk suture technique; after 12 operations the method was replaced by repair with continuous suture technique. In the flaccid, arrested heart the defect assumes a slitlike appearance and in most instances the closure is simple. After approximation of the edges of the defect the continuous suture may be reinforced by a series of interrupted stitches. This technique is similar to that used in

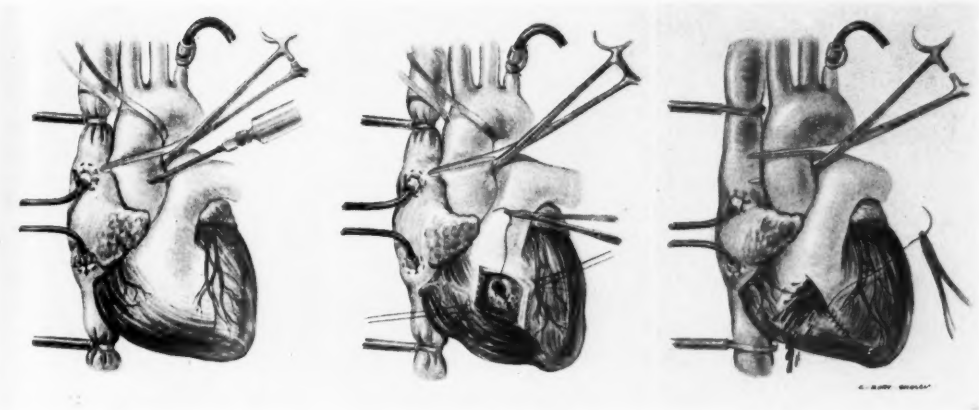

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FIG. 1. Schema demonstrating Melrose technique for elective cardiac arrest. a, After catheterization of the aortic arch and the cavae for the conventional heart bypass, the patient is started on the "oxygenator run." Both cavae are ligated with tapes around their enclosed cannulas. The aorta previously has been mobilized and a traction tape used to guide the occluding aortic clamp. Following occlusion of the proximal aorta, the potassium citrate-blood mixture is injected into the aortic root until asystole is produced. The injection is made as rapidly as possible with a 20 gauge needle—note the plastic needle guide that prevents inadvertent perforation of the entire vessel. b, Closure of uncomplicated interventricular septal defect through right ventriculotomy incision. The closure is usually made by direct suture with a continuous stitch that is then reinforced by a series of interrupted sutures. With the arrested heart it is possible to inspect the interior of the pulmonary artery, visualize the annulus of the aortic valve, and perform digital examination of the right auricle and its septum. c, Elective arrest is terminated by removing the occluding aortic clamp. This permits direct perfusion of the coronary vessels and the potassium solution is returned via the coronary sinus to the right side of the heart. The caval ligatures usually are released at the same time. It is common practice to allow the initial blood return to escape through the incompletely closed ventriculotomy incision. In theory, most of the potassium solution will escape with the initial blood return from the right side of the heart.

closing the incision for ventriculotomy. It is unusual for a suture to pull free or tear the membranous or muscle tissue of either septum.

Restarting the heart. The method of restarting the quiescent heart is as simple as that of inducing arrest. While the cardiac incision is being closed, the aortic clamp is removed and coronary perfusion is re-established and flushes out the potassium solution (Fig. 1c). This is followed by spontaneous contraction of the heart muscle and, in most cases, a normal sinus rhythm soon is established. Coronary perfusion washes the potassium citrate into the right side of the heart; it then enters the general circulation or escapes through the partially closed cardiac incision. It is an interesting fact that the bond between the potassium solution and the paralyzed muscle fiber is so tenuous that it may be severed instantly by simple perfusion of oxygenated blood.

There are several factors that affect the promptness with which normal cardiac action is restored. The surgeon's awareness of these factors together with practice in the laboratory will permit successful application of cardiac arrest for open-heart surgery. (1) The arterial return from the pump-oxygenator must give adequate perfusion to the aortic arch; should the cannula direct its flow into the descending aorta, perfusion of the coronary vascular bed may be inadequate. A poor perfusion may produce serious myocardial anoxia. (2) The patient's body temperature should be maintained as close to normal as possible (above 34 degrees Centigrade); should it fall to hypo-

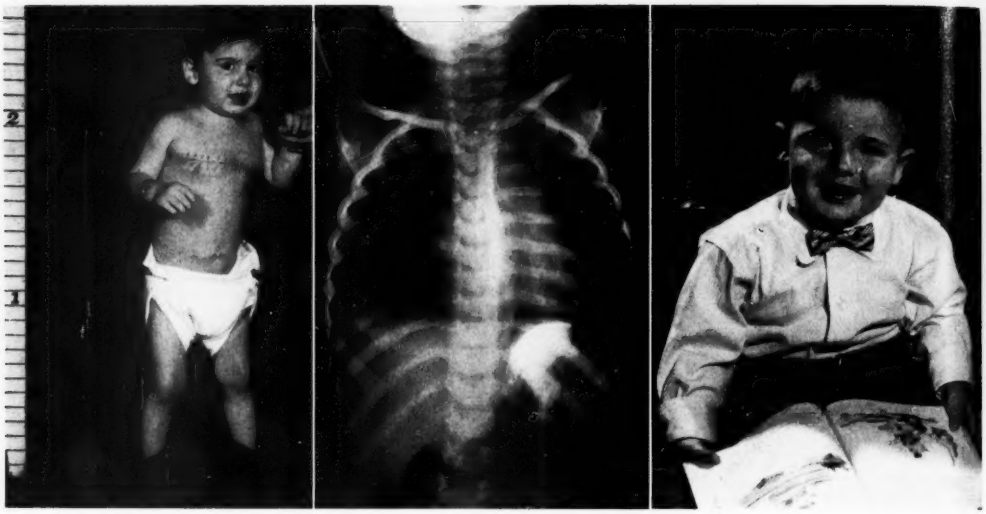

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FIG. 2. Patient K. B., aged 17 months (No. 1, Table I). The authors believe that this is the first patient whose interventricular septal defect was successfully closed under elective cardiac arrest. This defect was closed with interrupted silk suture technique; the duration of arrest was 13 minutes. a, Fourteen days after operation; b and c, approximately 8 months after operation. Repeat catheterization studies indicate normal cardiac dynamics.

thermic levels during the "pump run," extreme ventricular irritability may ensue.

Arrhythmias. Occasionally air will be trapped in the left side of the heart and, as the beat resumes, this air will be expelled from the left ventricle and be diverted into the coronaries by the aortic perfusion. Coronary air emboli are best removed by continued high flow perfusion. When this has been accomplished, the ventricular arrhythmia produced by the air bubbles may revert spontaneously to an effective normal rhythm.

If the ventricles start to fibrillate instead of resuming an effective beat there may be misgiving on the part of the surgeon and his team. They may hastily condemn elective cardiac arrest and wish fervently that it had not been used. However, it should be remembered that arrhythmia *always* is a potential complication of open-heart surgery, whether or not elective cardiac arrest is employed. More important, it should be remembered that temporary arrhythmia does no harm as long as the patient is adequately maintained by the pump-oxygenator. In most cases ventricular tachycardia or ventricular fibrillation spontaneously will revert to sinus rhythm if a good coronary perfusion is maintained until air emboli or any factor producing myocardial ischemia has been removed. Until restoration of normal rhythm, patience on the part of the surgical team is the ultimate in virtue. As a general rule, we maintain a high flow perfusion for at least 10 minutes after onset of ventricular arrhythmia; if it does not convert spontaneously during that period, rearrest is produced either by potassium citrate solution or by electric shock; these methods have not failed.

It is possible to detour the greater part of the potassium citrate solution from the circulation. Although this is by no means mandatory, it can be accomplished by removal of the aortic occluding clamp before the ventricular incision is completely closed. As coronary perfusion resumes, the initial flow of blood within the right heart

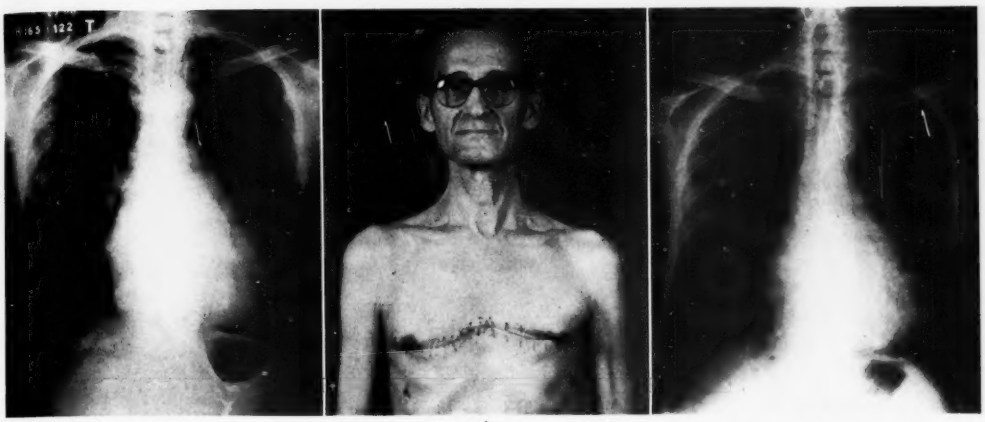

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FIG. 3. Patient C. H., aged 55 years (No. 25, Table I). This man underwent surgical correction of severe mitral insufficiency. Duration of elective cardiac arrest was 58 minutes, the longest period of induced cardiac arrest employed in this series. a, Preoperative roentgenogram. b, Four and one-half months after operation. c, Four months after operation; showing reduction in over-all size of the heart.

chamber will contain most of the potassium citrate solution. If the ventricular incision already has been closed, the flaccid heart occasionally may dilate before satisfactory tone is restored to the myocardium. It has been our practice to sacrifice from 100 to 200 milliliters of blood by removing the aortic clamp before completely closing the ventriculotomy incision. As in most new procedures, experimental experience is necessary before the elective cardiac arrest may be successfully employed.

EXPERIENCE

Elective cardiac arrest was first used clinically at the Cleveland Clinic Hospital on February 13, 1956. The patient was a 17 month old boy who successfully underwent elective cardiac arrest for 13 minutes while an interventricular septal defect was repaired at open cardiotomy (Fig. 2). It is our belief that this is the first successful case in which elective cardiac arrest has been used to close a septal defect.

Since that time we have performed 55 open-heart operations. In all but 4 cases the heart has been stopped by the Melrose technique. The pertinent data of each arrested case have been recorded in Tables I and II.

DISCUSSION

Duration of cardiac arrest. The maximum length of time that cardiac arrest can be tolerated under conditions of open-heart surgery is still not known. In this series the period of arrest has varied from 10 to 58 consecutive minutes. The longest period of arrest in this group occurred in an operation for severe mitral insufficiency secondary to ruptured chorda tendinea; the 55 year old patient's heart was arrested for 58 minutes while adequate repair was being accomplished. It is significant that the patient's heart action resumed promptly and that his hospital course was uneventful in spite of the magnitude of the operative procedure and the long duration of the elective cardiac arrest (Fig. 3). Kolff has demonstrated that a dog's heart will resume a sinus rhythm after 3 hours of arrest, also that a dog's heart may be stopped and restarted repeatedly without obvious signs of myocardial damage.

Of the 51 patients who comprise our series, all but 1 were restored to a satisfactory

TABLE I.—ELECTIVE CARDIAC ARREST*: DATA FOR 30 LIVING PATIENTS

No. Patient	Age Wt., kgm.	Diagnosis	Pulmonary artery pressure,** mm. Hg	Amt. K* solution used, ml.	Duration of arrest, min.	Time on pump-oxygenator, min.	Cardiac recovery
1 K.B.	17 mos. 13	Interventricular septal defect	47/20	20	13	19	
2 C.C.	3 yrs. 14	Interventricular septal defect	76/22	17	17	27	
3 C.H.	9 mos. 6.8	Tetralogy of Fallot		7	15	22	Ventricular fibrillation; rearrested*; restarted effective beat
4 R.P.	4 yrs. 15.5	Interventricular septal defect	87/41	40	13	24	
5 M.E.	10 mos. 6.5	Interventricular septal defect	87/30	9	10	15	
6 R.B.	6 yrs. 23	Tetralogy of Fallot		23	23	27	
7 J.G.	5 yrs. 16	Interventricular septal defect	57/19	30	8	30	Slow to recover effective beat
8 J.B.	50 yrs. 16.5	Tetralogy of Fallot		20	14	24	
9 R.M.	5 yrs. 20	Interventricular septal defect	31/16	20	9	16	
10 K.M.	3 yrs. 14.5	Interventricular septal defect	66/21	20	19	26	Ventricular fibrillation; spontaneous conversion to effective beat
11 M.A.	20 mos. 7	Tetralogy of Fallot	34/12	10	15	25	
12 D.L.	6 yrs. 20	Tetralogy of Fallot		18	18	40	Ventricular tachycardia; spontaneous conversion to effective beat
13 R.D.	5 yrs. 18.7	Interventricular septal defect	80/20	20	12	24	
14 P.M.	5 yrs. 16.7	Interatrial septal defect and interventricular septal defect	120/65	17	22	35	
15 C.E.	2 yrs. 13	Interventricular septal defect	55/20	10	8	22	
16 H.K.	7 yrs. 23.3	Interventricular septal defect	70/40	20	10	35	Ventricular tachycardia; rearrested*; resumed tachycardia; rearrested*; resumed normal sinus rhythm briefly; complete atrioventricular dissociation for 4 days; reverted to first degree block
17 M.S.	3½ yrs. 13.5	Interventricular septal defect	66/12	10	13	22	
18 M.C.	14 mos. 12	Tetralogy of Fallot		10	15	25	
19 L.S.	32 yrs. 53	Interatrial septal defect, valvular pulmonary stenosis		20	26	34	
20 R.W.	9 yrs. 25.9	Tetralogy of Fallot		29	13	22	
21 J.D.	8 yrs. 34.5	Tetralogy of Fallot		40	19	30	
22 B.R.	30 yrs. 47	Pulmonary stenosis		40	22	44	Slow to recover effective beat

22 B.R.	30 yrs. 47	Pulmonary stenosis		40	22	44	Slow to recover effective beat
23 R.D.	14 yrs. 33	Ostium primum defect	20/4	25	19	55	Ventricular fibrillation; rearrested*; resumed fibrillation; arrested with electric shock; started with ventricular tachycardia converting to normal sinus rhythm briefly; complete atrioventricular dissociation for 3 days; reverted to first degree block
24 R.G.	10 yrs. 23.5	Tetralogy of Fallot		20	18	32	Ventricular fibrillation; spontaneous conversion to effective beat
25 C.H.	55 yrs. 52	Mitral insufficiency, ruptured chorda tendinea	96/36	115	58	84	Ventricular fibrillation; spontaneous conversion to effective beat
26 W.Z.	4 yrs. 13	Interventricular septal defect with mitral stenosis	119/64	32	25	45	Ventricular fibrillation; spontaneous conversion to effective beat
27 M.McC.	58 yrs. 62	Aortic stenosis		155	24	43	
28 C.J.	2 yrs. 10	Interventricular septal defect	75/33	11	25	41	
29 F.G.	47 yrs. 70	Interventricular septal defect	66/22	50	16	67	Ventricular fibrillation; arrested with electric shock; resumed effective beat
30 H.M.	28 yrs. 50	Interatrial septal defect	31/14	50	13	47	Ventricular fibrillation; arrested with electric shock; resumed effective beat

*With 2.5 per cent potassium citrate solution, Melrose technique.
**As measured with intracardiac catheter preoperatively.

cardiac rhythm after arrest; the exception was a 9 month old infant who was found to have a single ventricle in addition to other defects.

Status of cardiac arrest as surgical adjunct. Elective cardiac arrest as an adjunct to open-heart surgery is by no means generally accepted by surgeons. The most popular argument against it stresses that the cardiac action is essential for determining the correct placement of sutures. Proponents of this argument contend that suturing the septum of the quiescent heart increases the possibility of compromising conduction bundles and thereby increases the chance of causing serious cardiac block. To subscribe to this theory, one must be convinced that cardiac block is caused by a mechanical occlusion of conduction fibers, particularly by encircling sutures. Our experience leads us to discount both the argument and the postulated mechanism by which cardiac block is produced. Persistent cardiac block has been a factor in 7 of our patients; in 3 patients an unusual amount of myocardium was excised for relief of infundibular stenosis; in 1 patient the myocardial perfusion was dangerously inadequate because of improper positioning of the arterial cannula; in the 3 other patients severe defects of the ostium primum type had to be repaired. If our observations are valid, it would raise the possibility that cardiac block may be directly related to local ischemia of septal myocardium, and that it may occur more often in a beating heart with low perfusion rate, whose septum is injured by grasping forceps, stay sutures, and traction. It is of particular interest that a high incidence of persistent cardiac block without elective arrest has impelled several experienced surgeons to adopt elective cardiac arrest as a standard procedure in open-heart surgery.

A wary attitude toward elective cardiac arrest is based on the fear that a heart once stopped will not resume an effective rhythm. The occurrence of such a complication naturally would test the faith of any surgeon, particularly one whose experience with car-

TABLE II.—ELECTIVE CARDIAC ARREST*: DATA FOR 21 DEATHS

No. Patient	Age Wt., kgm.	Diagnosis	Pulmonary artery pressure,** mm. Hg	Amt. K* solution used, ml.	Duration of arrest, min.	Time on pump-oxygenator, min.	Cardiac recovery	Postmortem findings
1 L.C.	4 yrs. 13	Interventricular septal defect	85/6	16	10	17	Uneventful	Marked pulmonary artery sclerosis
2 W.H.	15 mos. 9.5	Interventricular septal defect	42/18	13	9	12	Uneventful	Moderator band obstructing right ventricular outflow tract
3 M.D.	4 yrs. 16.2	Interventricular septal defect	86/50	15	13	30	Ventricular fibrillation; rearrested*; established effective beat	Angiomatous transformation in small pulmonary veins
4 B.R.	7 mos. 3.3	Interventricular septal defect, multiple congenital anomalies		25	20	90	Persistent heart block of varying degree; never had effective beat	Second interventricular septal defect not closed
5 J.C.	7 mos. 4.9	Lutembacher's syndrome	45/15	8	14	16	Uneventful	Ostium primum closed; second interatrial septal defect not closed; mitral stenosis corrected (leaflet split). Mild pulmonary arteriolar hypertrophy; hemorrhagic pulmonary edema
6 M.J.F.	35 yrs. 51	Aortic stenosis		50	40	48	Period of ventricular tachycardia	Freely regurgitant valve cusp
7 S.S.	2 yrs. 11.6	Transposition	66/31	17	35	55	Ventricular fibrillation; spontaneous conversion to effective beat	Incomplete correction; massive intra-areolar pulmonary hemorrhage
8 J.K.	6 mos. 4	Interventricular septal defect	85/45	8	10	25	Uneventful	Incomplete closure; pulmonary congestion
9 J.P.	11 yrs. 30	Interventricular septal defect	85/50	18	12	29	Ventricular fibrillation; rearrested*; ventricular fibrillation; spontaneous conversion to effective beat	Acute endocarditis; ruptured tricuspid leaflet
10 R.R.	3 mos. 4	Transposition		6	37	46	Uneventful	Moderate pulmonary arteriolar hypertrophy
11 D.J.	8 mos. 7	Interatrial septal defect, cor triloculare biatrium, corrected transposition		10	20	50	Slow to establish effective beat; isopropylarterenol hydrochloride helped	Intentional partial closure of interventricular septal defect with partial occlusion left ventricular outflow tract
12 V.L.	3 yrs. 15	Tetralogy of Fallot		13	24	38	Uneventful	Partial closure interventricular septal defect
13 J.B.	5 yrs. 17	Transposition	95/65	20	50	100	Ventricular fibrillation persistent after rearrest* and electric shock; converted spontaneously after ½ hour to effective beat.	Hypertrophy of pulmonary arterioles and veins; patent ductus; pulmonary congestion
14 R.W.	16 yrs, 48	Interatrial septal defect, mitral regurgitation		80	26	40	Air in coronaries; no fibrillation	Dehiscence in mitral leaflet along suture line with

14 R.W.	16 yrs, 48	Interatrial septal defect, mitral regurgitation		80	26	40	Air in coronaries; no fibrillation	Dehiscence in mitral leaflet along suture line with fenestration
15 E.C.	34 yrs. 47	Interatrial septal defect, mitral stenosis and tricuspid insufficiency		90	26	80	Ventricular fibrillation resistant to shock; rearrested*; slowly regained effective beat	Acute myocarditis; regurgitant tricuspid valve
16 P.C.	1 yr. 7	Tetralogy of Fallot		7	22	50	Uneventful	Cerebral edema
17 C.G.	4 yrs. 17.4	Tetralogy of Fallot		12	12	26	Uneventful	Left pulmonary artery absent
18 C.B.	5 yrs. 11.6	Tetralogy of Fallot		18	21	32	Uneventful	Pulmonary valve cusps absent
19 M.W.	27 yrs. 57	Cor triloculare biatrium	100/73	90	42	95	Slow to regain effective beat. Had complete atrioventricular block	(No examination)
20 K.G.	7 yrs. 21	Ostium primum defect	65/25	50	26	44	Persistent complete atrioventricular block	Maldeveloped mitral and tricuspid valves with thickening and adherence to myocardium
21 P.C.	3 yrs. 15	Tetralogy of Fallot		12	22	35	Ventricular fibrillation; converted spontaneously to effective beat	Early focal myocardial necrosis

*With 2.5 per cent potassium citrate solution, Melrose technique.
**As measured with intracardiac catheter preoperatively.

diac arrest is limited and who had definite misgivings at the outset before producing the elective arrest. It is true that a significant number—12—of our patients whose hearts were arrested with potassium citrate did develop ventricular tachycardia or ventricular fibrillation as the heart restarted. At first the arrhythmia was looked upon as a forbidding complication even though conversion to an effective rhythm resulted in every instance. It is important that the knowledge gained in each case of ventricular arrhythmia has provided an obvious explanation for it. Although it was stated before, we wish to repeat that ventricular arrhythmias usually are brought on by: (1) air in the coronary vessels, probably entrapped in the left side of the heart during closure of the defect; (2) severe hypothermia induced by the open thorax and the cooling of the blood in the extracorporeal circuit; (3) low coronary perfusion frequently caused by improperly placed arterial cannulas which divert the main flow away from the coronary circulation and produce myocardial anoxia.

To understand the cause of ventricular arrhythmia is less important than to know the method of converting it to an effective rhythm. At first an understandable impatience dictated prompt intervention to convert the ventricular arrhythmia to cardiac arrest. This usually was done by reapplying the Melrose technique or, by applying electric shock. It was soon established that the time factor of ventricular fibrillation is of far less importance than is the maintenance of satisfactory coronary perfusion.

Experience taught us that the simple expedient of improving coronary perfusion (either by increasing the flow rate or by readjusting a faulty arterial cannula) prompted the majority of postarrest ventricular arrhythmias to revert spontaneously to sinus rhythm. The observation that ventricular fibrillation can spontaneously convert to sinus rhythm by improved coronary perfusion has been made repeatedly. It would seem that myocardial anoxia is

the most significant factor in producing the attendant major ills in open-heart surgery, and the correction of this single factor, usually by improving the perfusion, is followed by a satisfactory outcome. We believe that patience on the part of the surgeon is almost as valuable as an efficient pump-oxygenator. If after 10 to 15 minutes of good perfusion the ventricular arrhythmia persists, arrest may be reinduced with potassium citrate or by electric shock.

An instinctive argument against this valuable adjunct is the surgeon's fear that deliberate suppression of heart action is tempting death. Such a fear is understandable; however, it must be kept in mind always that the heart beat is only one of the so-called vital functions that is now subject to control under proper conditions. Indeed, the definition of death as being *the cessation of a vital function* is now no longer valid; perhaps the concept should be modified by stating that death is the *uncontrolled* cessation of a vital function.

SUMMARY AND CONCLUSIONS

1. The ideal surgical field for intracardiac operation is provided by elective cardiac arrest.

2. Experience in 51 operations employing elective cardiac arrest is discussed.

3. Elective cardiac arrest by the Melrose technique is, in the authors' opinion, the most valuable adjunct to open-heart surgery since the advent of the cross-circulation approach.

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THE TRANSFER OF WATER (DEUTERIUM OXIDE) ACROSS THE PLEURAL AND PERITONEAL MEMBRANES

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THE ABSORPTION of crystalloids and colloids from the peritoneal and pleural cavities has intrigued many investigators in the past. Recklinghausen, in 1863, described direct communications, by stomas, between the peritoneal cavity and the lymphatic system. His description of microscopic stomas in the peritoneum served as a ready explanation for rapid absorption of fluids from the peritoneal cavity. Kolossow, Muscatello, MacCallum, Dandy and Rowntree demonstrated that the stomas were artefacts. Starling, Heidenhain, and Hamburger found that diffusible dyes were promptly absorbed from the peritoneal cavity by way of the blood stream. Subsequently, Epstein showed that intraperitoneal infusions of bicarbonate solutions were rapidly absorbed and that intraperitoneal fluid instillations were relatively safe. He recommended that fluids be given by this route in those pediatric patients whose electrolyte needs were urgent and in whom there was no other adequate route available.

The present study of the transfer of deuterium oxide across the serous surfaces was undertaken to determine the rate of water exchange across the peritoneal and pleural membranes. Absorption of solutions from serous cavities has long been known to be accomplished by impeded diffusion into the intravascular space. Previously, the rate of this exchange has been difficult to evaluate, and depended in large part on indirect methods of approach as, for example, the measurement of recoverable dyes in experimental animals.

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In collaboration with the Mass Spectrometry Section of the National Bureau of Standards.

MATERIALS AND METHODS

This study was carried out on 4 patients. One hundred grams of deuterium oxide (99.8 per cent pure), as isotonic saline, was instilled into the serous cavity at operation or thoracentesis. Venous blood samples were taken at intervals of 5, 10, 20, 30, 60, 120, 180, and 240 minutes. The plasma was separated and sealed in ampules, then shipped via air to the Mass Spectrometry Section of the National Bureau of Standards where analysis was performed as previously described (7), except that water was reduced by hot uranium instead of by hot magnesium.

In brief, the deuterium content of the plasma was determined by converting the "free water" to hydrogen over hot uranium with subsequent analysis in the mass spectrometer for isotopic hydrogens. Analysis of standard mixtures of hydrogens indicated the mass spectrometer uncertainty to be of the order of 1 per cent for samples containing 0.3 atom per cent deuterium.

EQUILIBRATION TIME FOLLOWING INTRAPLEURAL INJECTION

PATIENT 1. This 27 year old colored male was admitted to the hospital with a traumatic (stab) left pneumothorax. His vital signs were normal and at no time was there evidence of a hemothorax. Approximately 850 cubic centimeters of air were withdrawn from the pleural space and 24 hours following admission, with the lung expanded, 100 grams of deuterium oxide were injected intrapleurally. Venous blood samples were then obtained at intervals for 240 minutes. His hospital course was one of progressive improvement, and he was discharged 4 days following the

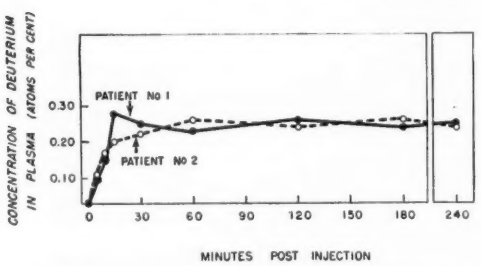

FIG. 1. Venous plasma deuterium concentration following intrapleural injection of deuterium oxide. Demonstrating the rapid passage of "heavy water" from the pleural space to the circulating plasma.

initial injury. His equilibration curve is demonstrated in Figure 1.

PATIENT 2. This 47 year old male suffered a stab wound of the right chest with a pneumothorax resulting. His vital signs were normal on admission; a hemothorax did not develop. The right lung was reexpanded by aspiration of 700 cubic centimeters of air, and following the aspiration 100 grams of deuterium oxide were injected into the pleural space. Venous blood samples were obtained as previously (Fig. 1).

PATIENT 3. This 15 year old female entered the hospital with typical symptoms and signs of early acute appendicitis. The routine laboratory studies were within normal limits. Under general anesthesia, an inflamed appendix was removed. Prior to closing the peritoneum, 100 grams of deuterium oxide were injected into the peritoneal cavity. Venous blood samples were obtained throughout the ensuing 4 hours. The equilibration curve is demonstrated in Figure 2.

PATIENT 4. This patient was a 28 year old female who had a tubal ligation, under spinal anesthesia, 2 weeks following delivery. As the peritoneum was being closed, 100 grams of deuterium oxide were injected into the peritoneal cavity and venous samples were collected as before (Fig. 2).

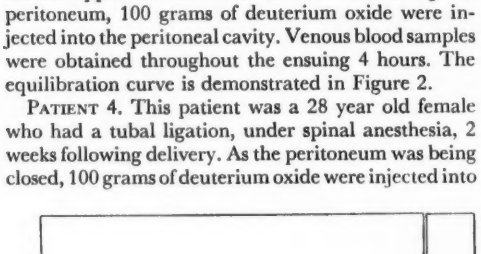

FIG. 2. Venous plasma deuterium concentration following intraperitoneal injection of deuterium oxide. Peritoneal fluid is not a sequestered pool but a dynamic part of the "circulation." Note the rapidity with which water leaves the peritoneal cavity.

The rate of the initial rise in plasma deuterium concentration depends upon two variables. The first is the rate of removal of the heavy water from the serous cavity and the second is the rate of diffusion from the intravascular space. These processes occur simultaneously. Patients 1 and 2 demonstrate the rapidity of the absorption of water from the pleural cavity. Equilibration apparently occurred within a period of 30 to 60 minutes following injection.

The equilibration time of deuterium oxide following intraperitoneal injection is demonstrated in Figure 2. The initial sharp rise of plasma deuterium concentration evidences the rapidity of the diffusion of water across the peritoneal membrane. Equilibration following intraperitoneal injection apparently occurred within a period of 60 minutes' time.

Previous study has demonstrated that equilibration following subcutaneous injection of deuterium oxide occurs within 2 hours, and the equilibration time following intramuscular injection into the thigh was 3 to 4 hours (8). By comparison, the equilibration time following injection of deuterium oxide into the pleural and peritoneal cavities is approximately 1 hour.

The pleura and the peritoneum are primarily dialyzing membranes, and the general rule of diffusion holds good insofar as the organ is in a state of health. Generally, the fluid of lesser concentration enters the denser medium with the rate of diffusion being rapid at first and then decreasing as the diffusion gradient decreases. There is no definite evidence that special openings or stomas exist in any part of the peritoneum or pleura as was first suggested by Recklinghausen; however, as recently as 1937, Allen and Vogt thought that they could again demonstrate stomas in the peritoneum. Schatten and associates found that fluid in the peritoneal cavity diffuses rapidly throughout the peritoneal cavity as studied with radioactive iodinated albumin. In the adult, there are

approximately 17,000 square centimeters of peritoneal surface which is about equal to the cutaneous surface area. Thus, fluid injected into a normal peritoneal cavity rapidly comes into contact with a large surface area through which the fluid passes. Similarly, Prentice and his associates demonstrated that when tritium was injected into ascitic fluid of patients, 40 to 80 per cent of the tritium left the peritoneal cavity within an hour. They concluded that ascitic fluid is part of a rapidly circulating medium rather than a segregated reservoir.

Following intravenous injection, deuterium oxide equilibrates within 30 to 60 minutes (9). This fact implies that during this time heavy water passes from the bloodstream throughout all the fluid of the body, including the intracellular spaces. Clauss, Barker, and Yacoubian demonstrated the rapidity with which water entered the pleural compartment after its (deuterium oxide) injection into the blood stream. Even though they were not able to determine a clear pattern to distinguish the hydrodynamics of various disease states causing pleural effusion, their data showed that the rate of water turnover was high, 30 to 75 per cent per hour of the total volume of the effusion.

Under the conditions of the current experiment, the concentration in the blood stream rose more rapidly and to slightly higher levels following intrapleural injection than after intraperitoneal injection. Since the peritoneal surface is larger, this might not have been anticipated. Two nonphysiologic conditions might have influenced this result, the addition of pneumoperitoneum and anesthesia to the patients undergoing laparotomy. Pneumothorax was not detectable at the time of study in 2 patients with stab wounds of the chest. The extent of injury, per se, was apparently not too different in all 4 patients.

The rapidity with which water crosses the pleural and peritoneal membranes probably reflects qualitatively the speed with which larger water-soluble molecules cross the barriers. Thus bacterial toxins, antibiotics, antibodies, or any intraperitoneal irrigant used at the time of laparotomy, probably cross rapidly the serous surface to enter or leave the blood stream.

Since molecular size is a definite factor in the rate of movement through a biologic membrane, and since it has been shown that erythrocytes injected intraperitoneally do not appear in the peripheral circulation in significant numbers, the therapeutic injection of blood or other fluids containing large molecules into the peritoneal cavity has been abandoned.

SUMMARY

The equilibration time of heavy water (deuterium oxide), following intrapleural or intraperitoneal injection of 100 grams, is approximately 1 hour. Pleural or peritoneal fluid is not a segregated collection but a dynamic part of the "circulation of the total body fluid."

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VAGINAL CYTOLOGY IN BREAST CANCER PATIENTS

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IT IS A COMMON OBSERVATION that vaginal cytology may reflect hormone status. The estrogens are known to give rise to cornification of the vaginal epithelium and the exfoliation of many cornified squamous epithelial cells in the vaginal smears.

The relatively increased exfoliation of cornified cells in the vaginal smears of patients suffering from cancer of the uterine cervix and cancer of uterine corpus was presented previously (1, 2). The present article represents a study of the vaginal cytology in patients with cancer of the breast. It was intended to observe: (a) if, as a group, vaginal smears from breast cancer patients are different from those of normal women, (b) if vaginal cytology is of any value in evaluating the progress of breast cancer patients undergoing castration, and (c) if vaginal smears are helpful in following the patient's course during hormone treatment.

MATERIAL AND METHOD

Between 1948 and 1956, at the Massachusetts General Hospital, Boston, 460 patients were treated for cancer of the breast who had had vaginal smears taken at one time or another during their course of treatment. The number varied with each patient from a single pretreatment smear to 67 smears taken during a long follow-up course. The method of evaluating the smears by counting the types of squamous epithelial cells differentially was similar to that described in the previous reports (1, 2).

Vaginal cytology by itself, except in the diagnosis of malignant lesions, gives limited information if it is not correlated with the patient's clinical course. Therefore, after the evaluation and recording of all the smears, the clinical records of these 460 patients were reviewed, and their progress was carefully recorded in relation to the time of vaginal smears, especially in those who were receiving hormone treatment. From the review of these records, some clinical aspects of special interest were analyzed and are noted in this report.

Since much of this work was retrospective, the evaluation of clinical response to hormone treatment was based largely on the clinical records alone. In many cases, the correct assessment was difficult. In order to be as objective as possible, a set of criteria was used. They served as a relatively unbiased standard for the analysis and comparison of cases in this report. The criteria used were:

1. All patients in this series who received hormone either as a primary treatment for inoperable cancer or for recurrence and metastasis were analyzed, except: (a) patients who received hormones for less than a 3 months' period, or (b) those who showed an initial favorable response but had been under observation for less than a year since the onset of hormone treatment.

2. The clinical response to hormone was classified as favorable, not favorable, or equivocal:

Favorable included: (a) patients with confirmed progressive local or distant soft tissue metastasis including lung metastasis, whose disease was rendered quiescent for more than 1 year, or actually showed evidence of regression under hormone treatment; (b) patients with progressive bony metastasis whose disease became stationary for more than 1 year and showed signs of recalcification; (c) patients with malignant cells in chest or ascitic fluid who survived comfortably for more than 1 year without frequent tapping; (d) patients with known (from laparotomy) liver, ovarian, or other peritoneal metastasis who had shown no observable progression of disease for more than 1 year under hormone treatment.

Not favorable included: (a) patients who died within 1 year of onset of hormone treatment; (b) patients whose over-all survival time was longer than a year but the beneficial effect of hormone was obviously less than a year so that other hormones or measures such as x-ray, castration, adrenalectomy, or hypophysectomy had to be resorted to.

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TABLE I.—COMPARISON OF TYPES AND METHODS OF CASTRATION

		Surgical castration, 75 cases	*X-ray castration, 36 cases*	*Combined 111 cases*
Prophylactic castration,	Lymph node metastasis	8(40%)	7(88%)	15(54%)
	Well more than 5 yrs.	10	5	15
28 cases	Well less than 5 yrs.	7	1	8
	Died within 5 yrs.	2	1	3
	Followed elsewhere	1	1	2
Therapeutic castration,	Lymph node metastasis	37(67%)	18(64%)	55(66%)
	Lived for 3–5 yrs.	7	5	12
	Alive, less than 5 yrs.	13	5	18
83 cases	Died within 3 yrs.	9	6	15
	Died within 1 year	23	8	31
	Followed elsewhere	3	4	7

Equivocal included: (a) patients whose original course progressed very slowly, and there was no obvious difference in the rate of progression under hormone treatment although the survival time was even longer than 5 years from the onset of the hormone treatment; (b) patients in whom different hormones were used and changed too frequently without an adequate observation time.

RESULTS

Certain Clinical Aspects of Cancer of the Breast

Multiple cancers in the body. Thirty-two of the 460 patients had cancer in another site in addition to the breast cancer, an incidence of 7 per cent. Cancer of the uterus, the most frequent second site, was present in 12 of the 460 cases (3 per cent). Seven patients had cancer of the corpus and 5 had cancer of the cervix.

Recurrent cases of cancer of the breast. Of the 460 patients, 87 had recurrent breast cancer which comprised 19 per cent of the total number. This observation indicates the importance of the problem of palliation in the management of breast cancer. The ratio may be somewhat higher in this series because of the cytologic factor which is the chief concern of this report. However, some patients may survive many years with recurrent or metastatic breast cancer.

TABLE II.—COMPARISON OF CASES WITH AND WITHOUT PROPHYLACTIC CASTRATION

	Prophylactic castration	*No castration*
Total No. of cases	28	205
Lymph node metastasis	15(54%)	110(54%)
Well more than 5 years	15	48
Well less than 5 years	8	56
Recurred or died within 5 years	3(11%)	65(32%)
Followed elsewhere	2	36

Castration. Among the patients in the present series, 111 were castrated; 75 had bilateral oophorectomy and 36 received x-ray castration. In 28 patients castration was done within 1 year of the radical mastectomy, when there was no detectable recurrence or metastasis. This group was designated as prophylactic castration. In the remaining 83 cases, castration was prescribed either for recurrence or as the primary treatment for inoperable cancer. This group was designated as therapeutic castration.

In Table I, the two groups of castration and the two methods of castration are tabulated. It seems that for prophylactic purpose, x-ray castration was as effective as oophorectomy; and for therapeutic purposes both methods were equally less helpful.

However, this comparison is not an analogous one as the two groups of patients were clinically different at the time when the castration was carried out. In order to see if prophylactic castration served a good purpose, a comparison was made between patients with and without prophylactic castration (Table II). Although there was marked discrepancy in the number of patients in the two groups, the patients who had prophylactic castration appeared to have a better prognosis than those who had not.

Ovarian metastasis. Table III shows the histology of ovaries in the 75 patients who were castrated by oophorectomy. The overall incidence of metastatic breast cancer in the ovaries was 17 per cent. However, the indications for which the ovaries were removed seemed to influence the number of

ovarian metastases. In the prophylactic oophorectomy group, all the ovaries were benign; and among the 11 patients in the therapeutic group whose metastases were confined to the skeletal system, none had metastasis in the ovaries. The entire number of 13 cases of ovarian metastases were in the group of 44 patients whose disease was in the soft tissues with or without concomitant bony metastasis. Among the patients who were not castrated and who died, 18 autopsies were performed, and 6 patients (33 per cent) had ovarian metastasis.

Relation of hormone response and hormone withdrawal effect. It seems that many patients with a good response to hormone administration but subsequent reactivation of their disease during prolonged treatment also showed a remission on withdrawal of hormone therapy. Among patients in this series who had a favorable response to estrogens, 80 per cent also had a good effect on withdrawal, and all the patients who had a good clinical response to androgens had withdrawal remission as well (Table IV).

Certain Cytologic Aspects of Cancer of the Breast

Vaginal cytology in breast cancer patients. All of the 460 patients had one or more vaginal smears at one time or another during their course of treatment. Thirty-six (8 per cent) of them had either atypical epithelial cells or definitely malignant cells by ordinary screening. Cancer of the cervix was subsequently confirmed in 4 of the cases, and 5 patients were known to have cancer of the corpus.

Comparison of vaginal cytology between women with and without breast cancer. Among the patients with primary breast cancer, 181 had vaginal smears before radical mastectomy. These smears were evaluated in regard to the amount of cornified cells and basal cells. They were then compared with the smears of 200 well women of the same age distribution (Table V). There was no obvious difference in the exfoliated cornified cells and basal cells in the vaginal smears of these two groups of patients (Fig. 1).

TABLE III.—OVARIAN HISTOLOGY IN 75 PATIENTS WITH OOPHORECTOMY CASTRATION

Ovarian histology	*Prophylactic oophorectomy*	*Therapeutic oophorectomy— Disease confined to bony system*	*Disease in soft tissue*	*Total*
Unrecorded	0	1	1	2
Normal	14	10	23	47
Simple cysts	3	0	2	5
Cystadenoma	1	0	1	2
Cortico-stromal hyperplasia	2	0	4	6
Metastatic cancer	0	0	13 (30%)	13 (17%)
Total	20	11	44	75

Vaginal cytology and castration. Generally, the clinical response of patients after therapeutic castration is rather unpredictable. The chronologic age and the menopausal history have been used as helpful rules to choose patients for the procedure but are by no means reliable in obtaining a favorable result. It was thought that perhaps vaginal cytology, before the castration procedure, might in some way be correlated with the clinical response and such findings might be of value in prognosticating favorable responses and thus helpful in selecting patients for castration. However, the data showed no real correlation.

Of the 10 patients who had a remission following castration and who had precastration smears, 3 showed marked cornification, 2 moderate cornification, and 5 essentially precornified smears. Among the 24 patients who did not respond to castration, 5 had marked cornification, 5 moderate, 12 precornified, and 2 atrophic smears.

TABLE IV.—HORMONE RESPONSE AND WITHDRAWAL EFFECT

	Withdrawal effect— Good		*Not good*
	No.	*Per cent*	*No.*
Estrogens			
Among favorable response cases—15 had a period of observation following withdrawal	12	80	3
Among unfavorable response cases—13 had a period of observation following withdrawal	1	8	12
Androgens			
Among favorable response cases—6 had a period of observation following withdrawal	6	100	0
Among unfavorable response cases—9 had a period of observation following withdrawal	2	22	7

TABLE V.—AGE DISTRIBUTION OF 181 PATIENTS WITH CANCER OF BREAST

Age groups, yrs.	*Patients*	
	No.	*Per cent*
20–29	0	0
30–39	8	4
40–49	46	26
50–59	52	29
60–69	35	19
70–79	29	16
80–89	11	6
Total	181	

It was then speculated that it might be possible to watch for a change in the cytologic picture following the castration in patients who responded well to castration. A shift of 20 per cent of any one type of the epithelial cells in the vaginal smears, either increase or decrease, was regarded as a change. In the postcastration remission group, 6 had smears both before and after castration; 2 of them had a shift in cellular population. Among those without a remission, 12 had smears and 4 of these had a shift. Therefore, a change in the cytologic picture following castration was not a practical guide in prognosticating the effectiveness of castration.

Vaginal cytology and hormone therapy. There were 209 patients in this series who received hormones of various kinds. However, since estrogens and androgens were the major hormones used, the analysis was confined to the patients who received either one or both of these hormones. After excluding the patients treated for less than 3 months and the patients with favorable response who were observed for less than a year, there were 138 cases available for analysis. Estrogens were used alone in 62 patients, androgens alone in 25, and a combination of two types of hormones in 51 cases. The dosages of various hormones followed those outlined by the Subcommittee of the Therapeutic Trials Committee of the American Medical Association (3).

TABLE VI.—ESTROGENS AND VAGINAL SMEARS

Smears	*No. of cases*	*Clinical remission*		*No remission*		*Equivocal remission*	
		No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
Markedly cornified	48	23	48	15	31	10	21
Not markedly cornified	37	2	5	30	81	5	14
Markedly cornified but fluctuated	18	0		6	33	12	67

It was thought that the initial vaginal smears from patients who did well with hormone therapy might differ from smears of those who did not; or that patients who responded favorably to estrogens and those who responded favorably to androgens might show different patterns in their initial smears. A careful study of these smears showed very little difference and therefore was of limited value.

Generally, a patient's clinical response was judged on the basis of the over-all course of the disease following hormone therapy. However, in many patients (51 in this series) more than one hormone was used, and the direct response to each hormone may not have been the same. In order to observe if the vaginal cytologic picture had any correlation with the clinical response to a hormone, the patient's clinical progress during treatment with a specific hormone was evaluated with the cytology of that treatment period.

A total of 103 patients receiving estrogens had repeated vaginal smears during the treatment. In 48 patients the smears became markedly cornified and remained so during therapy (more than 60 per cent of the cells were cornified), in 37 patients they were only moderately cornified, and in 18 cases the smears had become markedly cornified but the level was not maintained. Among those whose smears indicated marked cornification during estrogen therapy, 48 per cent had a clinical remission; and among those whose smears did not show marked cornification, only 5 per cent of the patients had a clinical remission (Table VI).

Forty-seven patients had repeated vaginal smears during androgen treatment. In 16 patients the smears showed very marked atrophy (more than 60 per cent of the cells were basal cells), in 27 cases atrophy was not marked, and in 4 cases the degree of atrophy fluctuated. Thirty-one per cent of those patients with marked atrophy of smears showed a clinical remission; while

only 7 per cent of those without atrophy had clinical remission (Table VII).

DISCUSSION

The incidence of metastatic breast cancer in the ovaries varies with different authors. In the present series it was 17 per cent. However, the number of ovarian metastases seemed to be influenced by the indications for which the ovaries were removed. Among the patients with prophylactic oophorectomy and the patients whose therapeutic oophorectomy was done for metastases confined entirely to the skeletal system, none had ovarian involvement. But of the patients who had soft tissue disease at the time of oophorectomy, 30 per cent had metastasis in the ovaries. It seemed likely that, when the mechanism of metastasizing breast cancer to the soft tissue was operating, ovarian tissue shared the susceptibility of other soft tissues in the body.

The close relationship between a favorable hormone response and a subsequent favorable withdrawal effect is a common observation and was noted in this series. In some cases it might be postulated that with successful hormone therapy the dosage was effectively large so that the clinical improvement was soon masked by the side effects of the hormone preparation. However, on withdrawal, the side effects were eliminated but the desirable influence initiated by the hormone persisted. This effect was evidenced in some cases by the vaginal cytologic picture in which there was a persistence of marked hormone effect after the discontinuance of the hormone.

Vaginal cytology of breast cancer patients, as a group, does not differ significantly from that of the control patients. The exfoliated cornified cells and basal cells were found to be quite similar in the two groups of patients in this study. Vaginal cytology was not helpful in selecting patients for castration or predicting the clinical response following castration. Nor was it helpful in selecting patients for suitable hormone treatment.

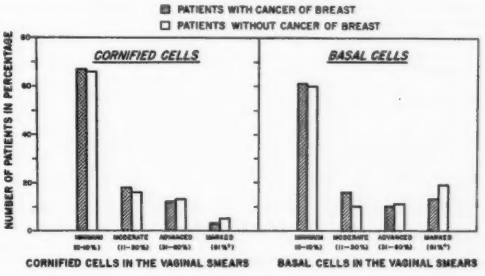
PATIENTS WITH CANCER OF BREAST
PATIENTS WITHOUT CANCER OF BREAST
CORNIFIED CELLS
BASAL CELLS
NUMBER OF PATIENTS IN PERCENTAGE
CORNIFIED CELLS IN THE VAGINAL SMEARS
BASAL CELLS IN THE VAGINAL SMEARS

FIG. 1. Comparison of exfoliated vaginal epithelial cells between patients with and without breast cancer.

However, vaginal cytology may be used to good advantage in following the patients during hormone therapy. There was a correlation between a favorable clinical response and a marked hormonal effect cytologically. It would seem reasonable to assume that in order to expect a clinical remission with hormone therapy, the vaginal smears should be made to show a marked hormone effect first. Furthermore, a correlation was also found to exist between patients' clinical refractoriness to a hormone and the insignificant hormonal effect seen in vaginal smears. It may be said, then, that many of the clinically so-called nonresponsive cases actually consisted of patients who received insufficient hormone therapy. Therefore, repeated vaginal smears at the initiation of hormone therapy, together with a scheduled increase in dose, should help to arrive at a dosage level that is optimum and effective for individual patients. The clinical evaluation of the patient's response to hormone therapy may be made only after vaginal cytology has shown a full hormonal effect.

The Subcommittee on Steroids and Hormones of the Committee on Research of the American Medical Association has chosen

TABLE VII.—ANDROGENS AND VAGINAL SMEARS

Smears	*No. of cases*	*Clinical remission*		*No remission*		*Equivocal remission*	
		No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
Markedly atrophic.	16	5	31	7	44	4	25
Not markedly atrophic.....	27	2	7	23	86	2	7
Markedly atrophic but fluctuated...	4	1	25	2	50	1	25

an arbitrary period of 3 months as the trial period for each hormone. If vaginal smears are used in helping to establish promptly an effective dosage level, perhaps much time may be saved and the clinical evaluation may be made earlier than 3 months. On the other hand, a minor group of patients in this series showed marked hormone effect in their smears but clinically showed no improvement. These patients may be regarded as having received sufficient hormone but are truly nonresponsive. Again, they may be differentiated from the former group by the use of vaginal smears.

On examination of the vaginal smears in individual cases, it was found that there were different degrees of sensitivity to hormone stimulation. This was seen most often in estrogen-treated cases. A certain dose of a specific preparation might give quite different levels of cornification in different patients. However, different preparations or different dosages of the same preparation might give a constant level of cornification in the same patients. Furthermore, in patients who were very sensitive to estrogens, small doses of any standard preparation were enough to produce full cornification. But in isolated cases of patients who were less sensitive, dosages as large as 60 to 80 times the usual could produce only moderate cornification. If these phenomena may be regarded as the sensitivity of vaginal epithelium to hormones, then the sensitivity of vaginal epithelium of different patients is not the same. Again, vaginal smears may distinguish the latter group of patients who were cytologically refractory from a previously mentioned group who were sensitive, but the unchanged cytology was due to the fact that insufficient hormone therapy had been administered.

In view of the fact that 3 per cent of the breast cancer patients in this series had uterine cancer as well, it seems worth while to have routine vaginal smears done for these patients. In addition, new chemical compounds are frequently presented for trial, each claiming its supremacy in delivering only the desirable effects of the natural hormone without side effects. Vaginal cytology should also be helpful in this respect, especially in testing compounds related to the ovarian steroids.

CONCLUSION

During hormone treatment for breast cancer, vaginal cytology is of value in observing the patient's clinical course. In the majority of the cases, those patients who have had a clinical remission to hormone also have shown a marked hormone effect in the vaginal cytology, and vice versa. This observation is especially obvious in the patients treated with estrogens. It may be concluded that a full hormone effect shown by vaginal cytology is a prerequisite for clinical remission. Therefore, repeated vaginal smears may be used at the initiation of hormone therapy, together with a scheduled increase in dose, to arrive promptly at a dosage level which is optimum and effective in individual patients. The evaluation of the clinical response to a hormone is made only after the cytology has shown a marked degree of hormone effect unless the patient is found to be cytologically refractory.

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EXPERIMENTS ON OCCLUSION OF THE ABDOMINAL AORTA IN NORMOTHERMIC DOGS

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THE ADVENT of excisional surgery of the aorta and its major tributaries has produced a need for knowledge concerning the physiologic effects produced by occlusion of the aorta. The necessity for temporary occlusion in the surgery and grafting of the aortic vascular tree is apparent. In addition, temporary aortic occlusion has been suggested and occasionally tested as a means of facilitating surgical procedures within the abdomen, particularly resection of multiple organs. Its potential value as a means of arresting uncontrollable hemorrhage and shock has been considered and needs further clarification. The experiments being reported are concerned with occlusion of the abdominal aorta in normothermic dogs. The occlusion was made at various levels of the aorta and for varying periods of time.

PAST EXPERIMENTAL DATA

Knowledge concerning the effects of occlusion of the aorta is still meager. The problem has been investigated heretofore by Carrel, Blalock, Gross, and others. Most of the information obtained, however, has been confined to observations concerning occlusion of the thoracic aorta. Whenever the aorta is occluded in the experimental animal at any level, there is concern with at least three phases of change and potential difficulty:

The first is the dynamic alteration in the cardiovascular system. The dynamic effects of occlusion have been studied by Watkins as related to occlusion of the thoracic aorta and can be summarized as follows: There is an immediate rise in blood pressure above the site of occlusion by 40 to 60 millimeters of mercury. Concomitantly, there is a slowing of the pulse rate and a precipitous fall of blood pressure below the site of occlusion. When the clamp is released, there is an immediate fall in blood pressure which gradually returns to pre-existent levels.

The second is the potential for ischemia and damage of nervous tissue. Damage to the spinal cord by ischemia with resultant paraplegia has been one of the major hazards of aortic occlusion, both experimentally and clinically. Its appearance is known roughly to be related both to the length of time of occlusion and the site of occlusion, the hazards increasing when the point of occlusion is moved proximally along the aorta. Our knowledge concerning this complication is imperfect, but it undoubtedly shares some relationship to the anatomic distribution of the blood supply to the spinal cord. In the dog, the major blood supply of the spinal cord is delivered along the anterior and posterior spinal arteries which run longitudinally. Of these, the anterior spinal artery is the largest and furnishes the greatest blood supply. Both the anterior and posterior spinal arteries receive important reinforcement from segmental vessels which arise along the cord. These tributaries are radicular arteries which spring from the intercostal and lumbar vessels. The radicular arteries are supplied in a variable and irregular fashion. From 7 to 13 anterior radicular arteries and from 6 to 11 posterior radicular arteries were found to supply the spinal cords of 14 dogs. The major blood supply to the lower regions of the spinal

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TABLE I.—GROUP I: OCCLUSION DISTAL TO THE INFERIOR MESENTERIC ARTERY

Experiment No.	*Time occluded, hrs.*	*Paresis*	*Death*
1	3	0	0
2	4	0	0
3	4	0	0
4	4	0	0
5	5	0	0
6	6	Temporary	0

TABLE II.—GROUP II: OCCLUSION PROXIMAL TO THE INFERIOR MESENTERIC ARTERY

Experiment No.	*Time occluded, hrs.*	*Paresis*	*Death*
1	4	0	0
2	6	Temporary	0
3	6	0	0

TABLE III.—GROUP III: LIGATION OF THE AORTA PROXIMAL TO THE INFERIOR MESENTERIC ARTERY

Experiment No.	*Paresis*	*Death*
1	0	0
2	0	0
3	Severe	Gangrene of bladder and rectum
4	0	0
5	Severe	Sacrificed in 2 weeks

cord entered in the region of the fourth or fifth lumbar vertebrae; the major blood supply to the upper cord entered in the cervical area. The mid-thoracic segment of the cord has the poorest local segmental circulation. There were ordinarily also large tributaries found in the region of the tenth thoracic segment.

The third is possible damage to abdominal viscera. Knowledge concerning the effects of occlusion of the abdominal aorta is exceedingly meager. A single comprehensive study of this problem was carried out by Burch and associates in 1954. Briefly, the results of this study in dogs can be summarized as follows: A maximum safe time of occlusion above the celiac axis was 20 minutes; above the superior mesenteric artery, 60 minutes; above the renal arteries, likewise 60 minutes; above the inferior mesenteric, 3 hours. When the abdominal aorta was occluded above the renal artery for longer than 1 hour, hindlimb paralysis occurred sporadically.

METHOD

The present study consists of 74 experiments carried out on mongrel dogs. The abdominal aorta was occluded for different intervals of time and at various levels within the abdominal cavity. There were 10 separate experiments which, for the purpose of simplicity, have been divided into four main categories according to the site of the occlusion.

The first category includes five groups of experiments which involve occlusion of the aorta, both below and above the inferior mesenteric artery.

Category I—Occlusion of the Abdominal Aorta Below and Above the Inferior Mesenteric Artery

In this category, including the first five groups of experiments, the peritoneal cavity was entered through a midline incision. The aorta was exposed at the site selected for the occlusion and subsequently clamped for a specified period of time with a Pott's artery forceps. When the aorta was ligated, the ligation was performed with umbilical tape. Division of the aorta, when carried out, was done between Pott's forceps. The aorta was closed with an over and over suture of No. 5-0 arterial silk. Both in the ligation and division of the aorta, care was taken in the dissection not to disturb any of the lumbar vessels arising above or below the point of occlusion.

Group I: Occlusion distal to the inferior mesenteric artery (*Table I*). Occlusion at this level was carried out in 6 dogs. All dogs survived without complication except 1 dog in which occlusion was produced for 6 hours. Hindquarter paralysis was noted in this animal which persisted for 1 week, then disappeared.

Group II: Occlusion proximal to the inferior mesenteric artery (*Table II*). There were 3 dogs in this group of experiments; all survived, but 1 animal suffered temporary hindquarter paralysis which ultimately disappeared.

Group III: Ligation of the aorta proximal to the inferior mesenteric artery (*Table III*). Five dogs were subjected to this group of experiments. Three of the animals survived with-

out complication. In 2, severe hindquarter paralysis resulted, and in 1 of these, gangrene of the bladder and rectum developed, causing death on the third postoperative day.

Group IV: Division of the aorta proximal to the inferior mesenteric artery (*Table IV*). Eleven dogs are included in this experiment. Only 3 of the animals survived without complication. Hindquarter paresis occurred in 5 of the animals, and in 7, death ultimately ensued because of two major vascular complications—(a) the development of gangrenous change in the bladder and rectum, or (b) the development of extensive gangrene in the anterior abdominal wall. The spinal cord was removed at autopsy or at the time of sacrifice in 4 animals. The cords were subjected to gross and microscopic examination.

In 2 of these animals, no hindquarter paralysis had been noted in the postoperative period, and on gross and microscopic examination, no abnormal changes were noted. In the other 2 animals, definite paralysis was present in the postoperative period and in each of them, examination of the spinal cord revealed changes in the lower dorsal and lumbar areas. These changes consisted of softening, chromatolysis, and shrinking of the neurons in the region of the anterior and posterior horns.

Group V: Renal excretion during aortic occlusion proximal to the inferior mesenteric artery. One animal was subjected to an acute experiment in which renal excretion was observed during a period of aortic occlusion below the level of the renal arteries. The femoral and carotid arteries were cannulated for observation of blood pressure, and the catheter was inserted into the bladder for observing urinary flow rate. Five per cent glucose in water was given intravenously in order to establish a continuous regulated flow of urinary output. A Pott's artery clamp was then applied immediately above the inferior mesenteric artery for a 30 minute period. No change of urinary output occurred.

TABLE IV.—GROUP IV: DIVISION OF THE AORTA PROXIMAL TO THE INFERIOR MESENTERIC ARTERY

Experiment No.	*Paresis*	*Death*	*Gangrene of bladder and rectum*	*Gangrene of anterior abdominal wall*
1	Severe	+	+	
2	Severe	+	+	
3	0	+		+
4	0	+		+
5	0	0		
6	Mild	+		+
7	Mild	+		+
8	Mild	0		
9	0	0		
10	0	0		
11	0	+		+

TABLE V.—GROUP VII: OCCLUSION OF THE AORTA ABOVE THE RENAL ARTERIES

No. of dogs	*Time occluded, hrs.*	*B.U.N. followed*	*Paresis*	*Death*	*Kidney biopsy*
2	1	No change	0	0	
1	1½	No change	0	0	N.D.A.R.*
7	2	No change	1 temporary	0	N.D.A.R.*
2	3	No change	0	0	
1	2½	No change	0	0	
Totals 13			1 temporary	0	2

*N.D.A.R. - No diagnostic abnormalities recognized.

Category II—Occlusion of the Abdominal Aorta Above the Origin of the Renal Arteries

The aorta was approached through an incision in the left flank, resecting the thirteenth rib. In this manner, the aorta could be easily exposed and the left renal artery and superior mesenteric artery visualized. The Pott's artery forceps was applied immediately below the level of the origin of the superior mesenteric artery. The abdominal wound was then closed about the Pott's clamp which was allowed to emerge from the flank, and at the end of the prescribed time, the clamp was simply removed and the remaining skin orifice closed. By this plan, the approach to the aorta was simple and generally performed in 15 to 20 minutes, being free of blood loss and minimal trauma. There were three groups of experiments in Category II.

Group VI. Two dogs were subjected to acute experiments to determine the effect on urinary excretion following occlusion of the aorta immediately above the renal arteries. Catheters were inserted into the right femoral and right carotid arteries and connected to

TABLE VI.—GROUP VIII: OCCLUSION OF THE AORTA ABOVE THE LEFT RENAL ARTERY AFTER RIGHT NEPHRECTOMY

Experiment No.	*Time occluded, hrs.*	*B.U.N.*	*Paresis*	*Death*	*Microscopic examination*
1	2½	Rose to 180	0	Died 5th p.o. day	Severe tubular necrosis and degeneration
2	2½	No change	0	0	No remarkable change
3	2½	Rose to 26	0	0	No significant change
4	3	Rose to 30	0	0	Slight glomerular proliferation, lymphocytes about tubules
5	3	Rose to 29	0	0	Mild changes in straight tubules

mercury manometers for observation of blood pressure, and a catheter was placed within the bladder for collection of urine. Infusion of 5 per cent glucose was given intravenously to establish a regulated urinary output prior to the period of clamping. The aorta was occluded respectively for ½ hour in 1 dog and 1 hour in the second dog. Needle biopsy specimens of the kidney were obtained before and after the period of clamping. In both animals, upon clamping of the aorta at the described site, the blood pressure rose immediately from levels of 110 to 120 millimeters of mercury respectively, to values of 160 and 170 millimeters of mercury. Following release of the clamp, the carotid pressure fell precipitously to a level between 80 and 90 millimeters of mercury and returned slowly to the pre-existing blood pressure. Pressure within the femoral artery during the period of clamping was noted to be approximately 20 millimeters of mercury. Urinary output fell immediately to 0 following application of the clamp to the aorta and remained thus until the clamp was removed, then it gradually returned over a period of 30 minutes to the preocclusion output. No alteration was noted microscopically in the kidney biopsy specimens following the period of occlusion.

Group VII: Occlusion of the aorta above the renal arteries (*Table V*). Thirteen dogs were subjected to occlusion of the abdominal aorta above the renal arteries and observed for varying intervals. The blood urea nitrogen determinations were secured prior to the experiment and observed subsequently for an interval of 7 to 10 days postoperatively. The period of occlusion varied from 1 to 3 hours. All dogs survived the procedure and only 1 of these dogs (occlusion for 2 hours) developed paresis of the hindquarters. This was temporary and disappeared after 1 week. None of the dogs showed any profound change in the blood urea nitrogen determination following this procedure.

Group VIII: Occlusion of the aorta above the left renal artery after right nephrectomy (*Table VI*). Because of the unusual results, a second experiment was devised and performed on 5 dogs. The experiment consisted of a right nephrectomy through a short rectus incision on the right side. Following this, the dog was again placed in the right lateral decubitus position, and through the operative approach as described for this category, the aorta was clamped above the left renal artery. Three dogs were subjected to occlusion for 2½ hours and 2 for 3 hours. All dogs survived without evidence of paralysis. Four of the 5 dogs had minor elevations of the blood urea nitrogen from normal levels up to 30 milligrams per cent, these values occurring within 2 or 3 days after the operative procedure, and returning to normal levels within a week's time. The remaining fifth dog was a dog which had been subjected to occlusion of the aorta above the renal arteries for 2 hours 2 months before. The dog had recovered without incident, and 2 months later was subjected to this experiment. The animal survived the procedure but went into progressive uremia. The blood urea nitrogen rose to 180 and the dog died on the fifth postoperative day. Microscopic examination of the right kidney, removed at the time of nephrectomy, failed to reveal any diagnostic abnormalities recognizable from the earlier occlusion 2 months previously. The left kidney which was secured at the time of autopsy, however, revealed severe tubular necrosis and degeneration.

Pathology. It has been possible to study the kidneys microscopically in 11 animals in which occlusion of the aorta has been carried out for various intervals above the renal arteries. This material includes needle biopsy, sacrifice, and postmortem specimens. It includes 2 dogs in group VI, 2 dogs in group VII, and 5 dogs in group VIII, plus 2 dogs subsequently to be mentioned in which the kidneys were studied after occlusion of the aorta above the superior mesenteric artery. With the exception of the 1 dog previously referred to in group VIII, sections of the kidney have failed to reveal any consistent change. In kidneys subjected to occlusion from periods of 2½ to 3 hours, changes have been noted indicating the occasional presence of hyalin casts, vacuolization of the collecting tubules, digitation of the glomerular tufts, and occasional increase in nuclei in the glomeruli. These changes, however, have not been consistent, nor have they been severe.

Category III—Occlusion of the Aorta Above the Superior Mesenteric Artery

The approach to the aorta was made through the resected bed of the thirteenth rib. The aorta was exposed above the superior mesenteric artery and was clamped by means of the Pott's artery forceps. The wound was closed about the clamp, which was removed at the end of the prescribed period of time.

Group IX: Occlusion of the aorta above the superior mesenteric artery (*Table VII*). In the first 3 dogs, the aorta was occluded for 1 hour in 1 dog and 1½ hours in 2 dogs. All 3 of these animals survived, but 1 dog subjected to occlusion for 1½ hours developed transient hindquarter paresis which lasted for 3 days. (It should be noted that this dog had a period of hypotension during the period of occlusion due to an overdose of intravenous nembutal.) Six dogs were subjected to occlusion for a period varying from 2 to 3 hours. Three of these dogs survived but the remaining 3 died within 24 hours, never recovering from the procedure and exhibiting bloody diarrhea and hematemesis prior to death.

TABLE VII.—GROUP IX: OCCLUSION OF THE AORTA ABOVE THE SUPERIOR MESENTERIC ARTERY

Experiment No.	*Time occluded, hrs.*	*B.U.N.*	*Paresis*	*Death*
1	1	Rose to 26	0	0
2	1½	No change	0	0
3	1½	Rose to 40	Temporary (3 days)	(Note: Dog had period of hypotension during clamping.) Sacrificed 1 month. Kidneys negative microscopically
4	2	No change	0	0
5	2	—	—	Died within 24 hours vomiting blood
6	2	No change	0	Sacrificed 6 weeks. Kidneys negative microscopically
7	2½	No change	0	0
8	3	—	—	Died within 24 hours vomiting blood
9	3	—	0	Died in 48 hours with bloody stools. Bowel shows mucosal congestion. Kidneys negative

Pathology. Gross autopsy findings on the dogs which failed to survive demonstrated the presence of a diffuse mucosal and submucosal hemorrhagic enteritis, which extended sharply from the level of the duodenum throughout the small bowel. The maximum changes were manifest in the duodenum and upper jejunum and again when the terminal ileum was approached. Similar changes were manifest in the rectum. Microscopic sections of the bowel showed surprisingly little alteration except for mucosal congestion and the nature of the cause of death is not apparent.

Category IV—Occlusion of the Aorta Above the Celiac Axis

The operative approach was again made through the left flank via the bed of the resected thirteenth rib. The aorta was dissected free and the celiac axis exposed. Prior to the application of the Pott's artery forceps, a wedge liver biopsy was obtained for comparison of specimens obtained following the period of occlusion. The Pott's artery forceps was applied to the aorta, the wound closed, and the clamp removed after the intended period of vascular interruption.

TABLE VIII.—GROUP X: OCCLUSION ABOVE THE CELIAC ARTERY

Experiment No.	*Time occluded, mins.*	*Paresis*	*Death*
1	30	0	0
2	30	0	0
3	30	0	0
4	45	0	0
5	45	0	0
6	45	+	+
7	60	Temporary	0
8	60	—	+ Bloody enteritis
9	60	0	0
10	60	—	+ Bloody enteritis
11	90	—	+ Bloody enteritis
12	90	—	+ Bloody enteritis

Group X: Occlusion above the celiac artery (*Table VIII*). Twelve animals in this group were subjected to periods of occlusion above the celiac axis for 30 to 90 minutes. No special preoperative or postoperative care was provided. Paralysis was noted to occur when the period of occlusion exceeded 30 minutes. Death was apt to occur when the occlusion lasted as long as 45 minutes.

Group XI: Occlusion above the celiac axis with antibiotic protection (*Table IX*). This group includes 7 dogs subjected to varying periods of occlusion. The blood pressures were observed by kymographic recordings, during and after the period of occlusion, for as long as 2 hours following the release of the clamp. The left carotid artery was cannulated and connected to a Phipps and Bird mercury manometer, and recordings were made on a Bird kymograph. The experiments were done cleanly, but without aseptic technique, and for this reason, the dogs were protected on the day of operation and for the first 4 days postoperatively when they survived, with 600,000 units of penicillin and ½ gram of streptomycin daily. Two deaths occurred in this group when the aorta was occluded for 1½ hours. Due to an error, 1 of these dogs had eaten immediately prior to the experiment, and at the time of surgery, the stomach was filled with a large meal. The dog survived the experiment, but died in 36 hours from acute gastric dilatation. Although it is interesting to note that antibiotic protection appears to increase the immediate salvage in this group of dogs, a very high incidence of hindquarter paralysis is noted in the survivors.

Pathology. In dogs which survived the period of occlusion above the celiac axis, it was possible to compare preocclusion and postocclusion specimens of the liver, and no essential change was noted in the postocclusion liver specimens in dogs surviving occlusion up to 1 hour. Two animals failed to survive occlusion of the aorta above the celiac artery for 1½ hours. They succumbed within 12 hours never recovering from the procedure. Autopsy study in both instances revealed severe, acute passive congestion of the liver and beginning central lobular necrosis. The spleens were small and contracted and showed evidence of frank necrosis of the follicles. There was a superficial enteritis in the bowel identical with that previously described for dogs succumbing to occlusion above the superior mesenteric artery. This change was readily apparent grossly but again microscopically was not remarkable. Two of the dogs in category IV were studied in regard to potential changes in peripheral blood. One of the dogs subjected to occlusion for 1 hour survived. The other dog subjected to occlusion for a period of 45 minutes died. Examination included prothrombin determinations, platelet counts, hemoglobin values, red blood cell count, white blood cell count, and differential counts. The determinations were secured before application of the clamp and 1 hour after the occlusion had been terminated. No remarkable changes were noted in any of these laboratory values. In 2 dogs in group XI, in which occlusion was allowed to exist for 1½ hours, studies were made in regard to the sedimentation rate and hematocrit. The determinations were obtained prior to occlusion and 30 minutes and 2 hours after the clamp had been removed. Both animals survived but no remarkable change was noted in the hematocrit or sedimentation rate during the period of observation.

DISCUSSION

A consideration of the effects of occlusion of the abdominal aorta must be made separately for the specific level at which the occlusion is performed. It is obvious that the dog can tolerate long periods of occlusion, generally speaking, at levels below the renal arteries, certainly up to 4 hours, without particular hazard. When occlusion is prolonged beyond this period of time, there are two potential sites of difficulty: (1) hindquarter paralysis is apt to occur, and (2) gangrenous changes may be precipitated in the region of the bladder, rectum, and lower anterior abdominal wall. The situation, as far as the nervous system is concerned, is not too comparable with that in man since the spinal cord in the dog descends to the level of fifth lumbar vertebra. From the work of Tarazi and associates, it appears certain that in a high percentage of dogs, lumbar vessels below the inferior mesenteric artery supply large collaterals to the anterior and posterior spinal arteries. The spinal cord apparently at this level gets a good deal of its collateral arterial supply via these channels which send vascular tributaries proximally to supply the upper lumbar and lower thoracic portions of the spinal cord. It is this portion of the cord, namely, the upper lumbar and lower thoracic areas, which receives smallest radicular arteries and which has the poorest collateral supply and appears to be most vulnerable to the effects of temporary ischemia.

In reference to occlusion above the renal arteries in the dog, we have been surprised by the minimum amount of damage detectable after occlusion of the aorta up to periods of 3 hours. This is much in contradiction to the report of Burch, who noted that occlusion beyond the period of 1 hour was apt to result in kidney damage and uremia. On the other hand, our results are remarkably similar to those of Moyer, Heider, Morris, and Handley. It is obvious that many factors may explain the difference in outcome from one investigation to another, and even the smallest details of the method may greatly influence the ultimate results. For example, an operative approach through a ventral incision exposing the aorta above the renal arteries is difficult and traumatic. Factors such as hypotension, trauma, and sacrifice by design or error of lumbar or collateral aortic branches will gravely influence the manner in which simple occlusion is tolerated. The fact remains that the kidney, when deprived of its usual source of arterial blood by a clamp applied immediately proximal to the origin of the renal arteries, will withstand such deprivation without difficulty up to a 2 hour period and presumably up to 3 hours. We have come to assume from experiments in shock that when the kidney is subjected to periods of hypotension for 2 hours or more, renal shutdown is inevitable. This would give some credence to the idea that at least other factors besides mere deprivation of blood supply must exist in shock in order to induce the changes usually noted in lower nephron nephrosis.

TABLE IX.—GROUP XI: OCCLUSION ABOVE THE CELIAC AXIS WITH ANTIBIOTIC PROTECTION

Experiment No.	*Time occluded, mins.*	*Paresis*	*Death*
1	30	0	0
2	60	+	0
3	90	+	+ Gastric dilatation
4	90	Mild	0
5	90	+	+
6	90	Mild	0
7	90	+	0

Once the point of occlusion is transferred proximally to a point above the origin of the superior mesenteric artery of celiac axis, one encounters new problems. Presumably, the safe period of time for occlusion above the superior mesenteric artery does not exceed 1 hour, and above the celiac axis 30 minutes. Periods of time beyond these intervals are apt to result in hindquarter paralysis indicating that important collateral blood supply to the spinal cord occurs in this particular area. Furthermore, one encounters a new shock-like state which occurs after prolonged clamping at these levels which is clinically characterized by bloody diarrhea and hematemesis. The etiology of this change

within the gastrointestinal tract is not clear, but it is remarkably similar to gross changes which have been noted in dogs under conditions of hypothermia and hemorrhagic shock. There is general belief that the rapid deterioration of animals which occurs following excessive occlusion above the celiac artery is dependent upon alterations and failure of the liver. Our experiments indicate that penicillin and streptomycin offer an increase in the survival rate at this level. This increased protection may arise in the same fashion as noted by Markowitz and associates in regards to ligation of the hepatic artery. In any event, in the dogs that do survive, the incidence of hindquarter paralysis following occlusion beyond 30 minutes is very high and has been unaffected by any improvement in visceral physiology.

SUMMARY

Seventy-four experiments have been carried out in which occlusion of the abdominal aorta was performed at various levels and for varying periods of time in the normothermic dog. It was noted that a dog can withstand long periods of aortic occlusion below the renal artery up to periods of 4 hours without complication. Beyond this interval, hindquarter paralysis is apt to occur with changes arising in the lumbar and dorsal cord. These changes are apparently dependent upon the existence of large collaterals to the spinal cord arising in levels of the fourth and fifth lumbar vertebrae. The dog likewise tolerates occlusion above the renal arteries certainly up to 2 hours, and more probably up to 3 hours, without provoking marked change in pre-existing normal renal parenchyma and without provoking hindquarter paralysis. Once the occlusion is shifted to a point proximal to the superior mesenteric artery or celiac artery, the tolerance to aortic occlusion is strikingly decreased. This is presumably on the basis of important intrinsic blood supply to the spinal cord at these levels and important blood supply to the abdominal viscera. Occlusion above the superior mesenteric artery is tolerated up to 1 hour and above the celiac axis, up to 30 minutes. Antibiotics, particularly penicillin and streptomycin, appear to offer some protection to the experimental animal against visceral changes occurring after prolonged occlusion of the aorta above the level of the celiac artery.

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THE SMALL BENIGN AND MALIGNANT GASTRIC LESION

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THE PURPOSE OF THIS ARTICLE is to present an analysis of data pertaining to certain anatomicopathologic, clinical, clinicopathologic, roentgenologic findings, the surgical treatment, and the results for 779 patients with benign and 226 with malignant gastric lesions removed surgically at the Mayo Clinic in the years 1940 to 1945, inclusive. The data from the 226 small gastric cancers have been reported previously (2).

SELECTION OF MATERIAL

From 1940 to 1945, inclusive, benign gastric ulcers were removed surgically from 795 patients, and adenocarcinomas of the stomach from 924 at the Mayo Clinic. At first thought it would appear proper to compare the data from the two groups. However, if the 795 benign gastric ulcers and the 924 gastric adenocarcinomas removed during these years are grouped according to size (greatest surface dimension[1] as measured by the pathologist, Table I), it is seen that the frequency of benign gastric ulcer declines markedly when the diameter of a given gastric lesion exceeds 2 centimeters, and drops to a small percentage when the diameter exceeds 4.0 centimeters. The frequency of carcinoma, however, increases gradually as size increases; the diameters of only 24.5 per cent of the carcinomas measured less than 4.1 centimeters. Almost certainly a lesion with a diameter exceeding 4.0 centimeters is cancerous, as Alvarez and MacCarty pointed out. Because the diagnosis and treatment of lesions of such size are rarely in doubt, from a practical standpoint little can be gained by comparison of data from lesions with diameters greater than 4.0 centimeters. We have limited our study, therefore, to the 779 benign and 226 malignant lesions 4.0 centimeters or less in diameter.

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[1]Hereinafter referred to as "diameter."

ANATOMICOPATHOLOGIC DATA

Benign gastric tumors, such as adenomas, fibromas, lipomas, myomas, as well as lymphosarcomas were excluded. One of us (Dockerty) has confirmed the adenocarcinomatous character of the malignant lesions and the grade of malignancy in this series.

The surgeon or the pathologist or both had noted a healed or active duodenal ulcer in 19 (8.4 per cent) of the 226 cases of small gastric adenocarcinoma and in 184 (23.6 per cent) of the 779 cases of benign ulcer. In the first group of 19, the duodenal ulcer was described as reactivated (gastroenterostomized stomach) in 1, active in 4, chronic in 2, healed in 4 and as a scar of an old ulcer in 8. The 184 cases in which both a duodenal and a gastric ulcer were found were compared with the 595 cases in which a benign gastric ulcer only was present, to determine whether age, sex, type and duration of symptoms, and gastric secretory activity were altered when a duodenal ulcer was present.

Certain anatomicopathologic data from 226 cases of small adenocarcinomas have been described previously (2). It is pertinent to recall that 3 of the small cancers were polypoid,[2] the remainder ulcerating.

Distribution according to size. The percentages of the 779 benign gastric ulcers whose

[2]Lesions diagnosed as carcinoma in situ affecting gastric polyps are not included in this study.

TABLE I.—DISTRIBUTION ACCORDING TO SIZE OF 795 BENIGN GASTRIC ULCERS AND 924 GASTRIC CARCINOMAS REMOVED SURGICALLY IN THE PERIOD FROM 1940 TO 1945, INCLUSIVE

	Benign gastric ulcer		*Carcinoma*	
Size, cm.	*No.*	*Per cent*	*No.*	*Per cent*
Less than 1.1	322	40.4	18	1.9
1.1–2.0	305	38.4	49	5.3
2.1–3.0	102	12.8	67	7.3
3.1–4.0	50	6.3	92	10.0
4.1–5.0	7	0.9	110	11.9
5.1–6.0	5	0.6	98	10.6
6.1–7.0	2	0.3	94	10.2
More than 7.0	2	0.3	396	42.8
Total	795	100.0	924	100.0

diameters were less than 1.1 centimeters, and from 1.1 to 2.0 centimeters, inclusive, were respectively 41.3 and 39.2, whereas the percentage whose diameters were 2.1 to 3.0 centimeters was only 13.1 and of those whose diameters were 3.1 to 4.0 centimeters, inclusive, was even less, being only 6.4. The percentage distribution according to size of benign ulcers with and without an associated duodenal ulcer was almost the same.

The percentage distribution according to size of the 226 gastric cancers is in definite contrast to that of the 779 small gastric ulcers. The percentages of 226 small gastric cancers in the groups whose greatest diameter measured less than 1.1, 1.1 to 2.0, 2.1 to 3.0, and 3.1 to 4.0 centimeters, inclusive, were, respectively, 8.0, 21.7, 29.6, and 40.7. The percentages of small gastric cancers increase, whereas the percentages of gastric ulcers decrease with size. Specifically, it should be noted that only 29.7 per cent of these small gastric cancers have diameters of 2.0 centimeters or less, whereas 80.5 per cent of the benign gastric ulcers are within this size range. Conversely, 70.3 per cent of these small gastric cancers, and only 19.5 per cent of the benign gastric ulcers have diameters ranging from 2.1 to 4.0 centimeters, inclusive.

Location. The pyloric segment in our study was defined as the pylorus and the adjacent 1 centimeter of the stomach and the antrum as the remaining portion of the lower third of the stomach. The location of the gastric ulcer according to the segment of the stomach was recorded in 589 of the 779 cases; the percentages of gastric ulcers found in the pyloric, antral, middle third, and upper third of the stomach, respectively, were 20.4, 30.6, 47.0, and 2.0; the percentage of gastric ulcers was approximately equal in the lower (pyloric plus antral portions) and middle thirds of the stomach. The percentage of gastric ulcers associated with duodenal ulcers appears to be slightly greater in the combined pyloric and antral segments (57.8) and slightly smaller in the middle third (41.4) than when a gastric ulcer only was present, respective percentages being 48.9 and 48.7.

The distribution of small gastric cancer according to segment of stomach appears to be somewhat different from that of benign gastric ulcer. Only 51.0 per cent of the benign gastric ulcers were found in the combined pyloric and antral segments whereas 80.0 per cent of small gastric cancers were found there. Conversely, 47.0 per cent of benign gastric ulcers were found in the middle third of the stomach, in contrast with 17.8 per cent of small gastric cancers. In short, gastric ulcer was found with about equal frequency in the lower and middle thirds of the stomach, whereas gastric cancer was distinctly more frequent in the lower third than in the middle third of the stomach. Only a small percentage of surgically removed gastric ulcers and cancers in this range of sizes in these years were in the upper segment of the stomach.[3]

Six hundred and twenty-seven of the 779 gastric ulcers were definitely located on the lesser curvature, greater curvature, anterior wall, or posterior wall. A majority (83.6 per cent) was found on the lesser curvature. Only 13.1 per cent were found on the posterior wall, 2.6 per cent on the greater curvature, and 0.8 per cent on the anterior wall. The percentage distribution in these locations was essentially the same when gastric ulcer alone was present, and when gastric and duodenal ulcers were present. These

[3]In a study of Schell, Dockerty, and Comfort the incidence of carcinoma involving the proximal reaches of the stomach exceeded 50 per cent when the carcinoma occurred as a complication of clinical pernicious anemia.

TABLE II.—AGE AND SEX DISTRIBUTION OF PATIENTS WITH BENIGN GASTRIC ULCER AND GASTRIC CARCINOMA REMOVED SURGICALLY IN 1940 TO 1945, INCLUSIVE

Age, yrs.	Total				Males				Females			
	Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
10–19	1	0.1	—	—	1	0.2	—	—	—	—	—	—
20–29	9	1.2	3	1.3	8	1.2	2	1.1	1	0.8	1	2.3
30–39	86	11.0	13	5.8	79	12.0	11	6.0	7	5.7	2	4.5
40–49	236	30.3	48	21.2	199	30.3	41	22.5	37	30.1	7	15.9
50–59	282	36.2	75	33.2	239	36.5	62	34.1	43	35.0	13	29.6
60–69	144	18.5	66	29.2	118	18.0	49	27.0	26	21.1	17	38.6
70–79	21	2.7	21	9.3	12	1.8	17	9.3	9	7.3	4	9.1
Total	779	100.0	226	100.0	656	100.0	182	100.0	123	100.0	44	100.0
Mean, yrs.	51.8		56.1		51.3		55.8		54.2		57.5	

Longest diameter of lesion measured 4.0 cm. or less.

percentages should be compared with those for small gastric cancers. Of these, 68.3 per cent were on the lesser curvature, 15.7 per cent on the greater curvature, 8.0 per cent on the posterior wall, and 8.0 on the anterior wall. The percentage both of benign gastric ulcer and of ulcerating carcinoma is small on the greater curvature and anterior wall. These percentages and statements do not refer to the incidence of carcinoma of all sizes in the different locations.

Multiplicity of lesions. The percentage of cases in which more than 1 benign gastric ulcer occurred appeared to be greater when a duodenal ulcer was present (23.4 per cent) than when a duodenal ulcer was not present (13.1 per cent). Multiple benign gastric ulcers were found (15.5 per cent) about 3 times as frequently as multiple gastric carcinomas (4.9 per cent) of the same size range.[4]

SEX INCIDENCE

In the benign ulcer group, males numbered 656 (84.2 per cent) and females 123 (15.8 per cent). The percentages of males with gastric ulcer alone (84.5) and with both gastric and duodenal ulcer (83.2) were almost identical. Moreover, the percentages of males, 80.5, and of females, 19.5, with small gastric carcinoma were strikingly similar to those with benign gastric ulcer.

AGE INCIDENCE

Distributions according to decade of life and mean ages for benign ulcer and small gastric cancer are shown in Table II. Benign gastric ulcers were more frequent than gastric carcinomas before 60 years of age, and after that age the small gastric cancers were the more frequent. Distributions of benign gastric ulcer according to decade of life among men and women were remarkably similar. However, the mean age of the 656 males (51.3 years) was slightly less than the mean age of the 123 females (54.2 years). Mean ages of males (51.7 years) and females (55.2 years) with gastric ulcer only and those of males (49.9 years) and females (50.8 years) with gastric ulcer associated with duodenal ulcer were similar to mean ages of the total group and to one another. Mean ages of males and of females with small gastric carcinoma were greater, however, being respectively, 55.8 and 57.5 years. The patients in the benign series were, on the average, 4½ years younger than those in the malignant group (51.8 years as compared to 56.1 years). The increase of small gastric cancer after the age of 60 years is reflected in the higher mean age for such patients.

SYMPTOMATOLOGY

The cases of benign gastric ulcer were divided according to symptoms into three groups. Group 1 was comprised of cases in which the symptoms were typical of peptic ulcer. Group 2 was comprised of cases in which the patient complained of an ulcer type of distress with relief on ingestion of food or alkalies, but the symptoms were continuous, lacking periodicity and other

[4] In a parallel study of gastric carcinoma associated with clinical pernicious anemia the incidence of multiple primary carcinomas was 25 per cent (3).

TABLE III.—DURATION OF SYMPTOMS IN RELATION TO SIZE OF SMALL GASTRIC ULCER AND GASTRIC CARCINOMA REMOVED SURGICALLY IN 1940 TO 1945, INCLUSIVE

Duration of symptoms, yrs.	*Diameter of lesion*															
	1.1 cm.				*1.1—2.0 cm.*				*2.1—3.0 cm.*				*3.1—4.0 cm.*			
	Gastric ulcer		*Carcinoma*		*Gastric ulcer*		*Carcinoma*		*Gastric ulcer*		*Carcinoma*		*Gastric ulcer*		*Carcinoma*	
	No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
Less than 1	50	15.5	2	11.1	60	19.7	12	24.5	23	22.5	27	40.3	11	22.0	47	51.1
1	20	6.2	4	22.2	21	6.9	5	10.2	7	6.9	9	13.4	4	8.0	6	6.5
2–5	49	15.2	2	11.1	59	19.3	17	34.7	17	16.7	13	19.4	10	20.0	19	20.7
More than 5	203	63.1	10	55.6	165	54.1	15	30.6	55	53.9	18	26.9	25	50.0	20	21.7
Total	322	100.0	18	100.0	305	100.0	49	100.0	102	100.0	67	100.0	50	100.0	92	100.0

details which one expects in the presence of a clear cut ulcer. Group 3 was comprised of those cases in which the history was not of ulcer at any time. The symptoms were typical of ulcer in 458 (58.8 per cent), atypical of ulcer in 231 (29.7 per cent), and not ulcerlike in 90 (11.5 per cent) of the 779 cases of benign ulcer; thus, 88.5 per cent of the benign gastric ulcers produced symptoms that were either typical or atypical of ulcer. The percentage (94.0) of cases with both duodenal ulcer and gastric ulcer in which symptoms were typical or atypical of ulcer was slightly greater than the percentage (86.7) of cases of gastric ulcer alone in which symptoms were typical or atypical of ulcer. In 62.0 per cent of the cases of small gastric cancer symptoms likewise were typical or atypical of ulcer. In other words, a majority of the benign gastric ulcers and small ulcerating carcinomas produce ulcer-like symptoms, symptoms of ulcer being more frequent in cases of benign ulcer, than of small ulcerating carcinoma.

TABLE IV.—COMPARISON OF GASTRIC SECRETORY ACTIVITY OF PATIENTS WITH GASTRIC ULCER AND GASTRIC CARCINOMA, 4.0 CENTIMETERS OR LESS IN LONGEST DIAMETER AND OF NORMAL PERSONS: 1940 TO 1945, INCLUSIVE

Sex	*Achlorhydria*		*Free acidity, units*	
	Per cent	*Difference**	*Mean*	*Difference†*
ALL BENIGN GASTRIC ULCERS				
Males	5.1	−12.1	40.0	−4.4
Females	9.1	− 9.7	32.0	−1.1
GASTRIC ULCER ALONE				
Males	5.6	−11.4	38.4	−5.9
Females	10.0	− 9.1	30.3	−2.9
GASTRIC ULCER WITH DUODENAL ULCER				
Males	3.5	−14.5	45.3	+0.5
Females	6.6	−10.5	36.2	+3.2
SMALL GASTRIC CARCINOMA				
Males	24.6	+ 9.6	34.4	−9.1
Females	35.1	+15.1	32.8	−0.7

*Percentage difference from incidence of achlorhydria for normal persons of corresponding age and sex.
†Difference from mean free acidity for normal persons of corresponding age and sex.

Duration of symptoms. The percentages of the 779 cases of benign gastric ulcer in which symptoms had been present less than 6 months, 6 to 12 months, 1 year, 2 to 5 years, and more than 5 years before surgical removal were respectively: 14.2, 4.2, 6.7, 17.3, and 57.6. A tendency was noted toward longer duration of symptoms before surgical treatment when both gastric and duodenal ulcers were present than when a gastric ulcer alone existed. The percentages of 226 cases of small gastric cancer in which symptoms had been present less than 6 months, 6 to 12 months, 1 year, 2 to 5 years, and more than 5 years before surgical removal were respectively: 26.5, 12.4, 10.6, 22.6, and 27.9. It is of much interest that more than half (57.6 per cent) of all the patients with benign gastric ulcers had had symptoms for more than 5 years; more so that about a fourth (27.9 per cent) of the patients with small gastric cancer had had symptoms more than 5 years, which is a period far greater than the life expectancy of most patients with gastric cancers after surgical treatment. The percentage of cases in which the duration of symptoms was greater than 2 years was 74.9, for the benign, and 50.5 for the malignant lesions. On the average then, gastric ulcers tend to have been present for longer periods before surgical treatment was carried out than small gastric cancer, but long duration of symptoms by no means excludes carcinoma.

Duration of symptoms in relation to size (*Table III*). When a relationship between duration

TABLE V.—GASTRIC ACIDITY VERSUS SIZE OF GASTRIC ULCER AND GASTRIC CARCINOMA REMOVED SURGICALLY IN THE YEARS 1940 TO 1945, INCLUSIVE

	Achlorhydria				*Free acidity, units*					
	Gastric ulcer		*Carcinoma*		*Gastric ulcer*			*Carcinoma*		
Size	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*Mean*	*No.*	*Per cent*	*Mean*
Less than 1.1	21	6.9	1	6.2	282	93.1	37.6	15	93.8	39.1
1.1–2.0	20	7.2	4	8.9	259	92.8	38.0	41	91.1	38.1
2.1–3.0	3	3.4	20	31.2	84	96.6	39.2	44	68.8	30.6
3.1–4.0	1	2.2	29	36.7	43	97.8	37.1	50	63.3	32.5
Total	45	6.3	54	26.5	668	93.7	39.0	150	73.5	34.1

Longest diameter of lesion measured 4.0 cm. or less.

and size was sought, a minor trend toward longer duration among the smaller and toward shorter duration among the larger benign ulcers was discernible, but this trend was not as marked as it is among small cancers.

Relation of type to duration of symptoms. Symptoms of benign gastric ulcer tended to be of longer duration when they were of the ulcer type than when they were nonulcer in type. Thus, 65.7 per cent of the patients with a history of ulcer and 25.3 per cent of those with a nonulcer history had had symptoms for more than 5 years. On the contrary, only 6.3 per cent of those with an ulcer type of history had had symptoms less than 6 months, whereas 39.2 per cent of those with a nonulcer type of history had had symptoms for a similar period. An ulcer type of history thus appears to be more tolerable to the patient, or less disturbing to the physician than the nonulcer type. The same trend was present among patients with small gastric cancers, but it was less marked.

GASTRIC SECRETORY ACTIVITY

Data obtained with the Ewald test meal employed at the Mayo Clinic were available in 713 of the 779 cases of benign ulcer, and in 204 of the 226 cases of gastric cancer of comparable size. Analysis of these data disclosed several points of interest.

Mean values (*Table IV*). The percentages of men and women with benign ulcers whose gastric contents did not contain free hydrochloric acid were well below those for normal men and women, and the mean free acidity of the gastric contents of the remaining men and women was somewhat below that of normal persons. When the secretory activity of patients who had gastric ulcer only and of those who had associated duodenal ulcer was studied also, the trend was the same in the group of gastric ulcers alone as in the total group of gastric ulcers. The same trend has been pointed out also among patients with benign gastric ulcer by Vanzant, Alvarez, Berkson, and Eusterman. In the group in which a duodenal ulcer as well as a gastric ulcer was present, the percentage incidence of achlorhydria appeared to be further below normal, but the mean values for free acidity were slightly above normal, gastric secretory activity being more like that commonly encountered in duodenal ulcer.

Secretory activity in the benign gastric ulcer group differed importantly from that in the small cancer group. The percentages of patients with benign ulcer whose gastric contents did not contain free hydrochloric acid were much less for both men and women, and mean free acidity of the remaining men was higher than that among men with small gastric cancer. The difference in mean free acidity among the women in the two groups was not great.

Relation to size (*Table V*). Gastric secretory activity in cases of benign ulcer apparently does not vary with size, but in cases of small gastric cancer it decreases with increasing size. Gastric secretory activity in the cases of gastric ulcer and small gastric cancer in which the longest diameter was 2.0 centimeters or less was similar.

Relation to type of history. The incidence of achlorhydria was slightly less among pa-

tients with gastric ulcers who had a typical ulcer history than among those who had an atypical ulcer or nonulcer history; conversely, the incidence of more than 40 clinical units of free acid was greater when the history was typical of ulcer than when it is atypical of ulcer or of nonulcer type. The incidence of 40 clinical units or less of free acid was not dissimilar in the three groups. Thus, patients with gastric ulcers with a typical ulcer history tended to have more gastric secretory activity than those with atypical or nonulcer histories. These same trends were noticeable to a more marked degree among patients with small cancers of comparable size (2).

Relation to duration of symptoms. Among patients with gastric ulcer the shorter the history, the higher the incidence of achlorhydria and the lower the incidence of free acid of more than 40 units. The same trends were present but more marked among patients with small cancer. Higher secretory activity occurred in patients with typical history of ulcer and in those with symptoms of long duration from both benign gastric ulcer and small gastric cancer.

ROENTGENOLOGIC DIAGNOSIS

The roentgenologic examination of the stomach has two objectives: Its first aim is to establish the presence of abnormality; the second is to interpret the elicited evidence of abnormality in terms of pathologic anatomy. Obvious, but not always remembered, is the circumstance that the evidence is entirely macroscopic, analogous to the inspection and palpation of an organ or tissue; the more definite microscopic diagnosis is in another realm, namely, that of the pathologist. It is fortunate, and, in a sense, surprising that the anatomicopathologic changes produced by gastric cancer and gastric ulcer can be seen and recognized for what they are at roentgenologic examination in such a high percentage of cases. Roentgenologic diagnosis by qualified roentgenologists rightfully deserves the great confidence physicians have come to place in it.

When gastric lesions were small, the roentgenologic diagnosis contained several diagnostic terms with great frequency. In most instances the terms "ulcer," "cancer," or "lesion" appeared. When the preponderance of roentgenologic evidence favored benignancy, as for instance, a sharply defined niche or crater, located in the midst of exaggerated and converging rugae, with local tenderness, perhaps with an incisura on the opposite curvature, with antral spasm and a tightly closed pylorus, transitory retention and active peristaltic activity, then the roentgenologist has tended to favor a diagnosis of benign ulcer. Conversely, when the crater or the niche was shallow and poorly circumscribed or irregular in outline, when local tenderness was absent, when the neighboring rugae were abnormally shallow or obliterated altogether, or when the pylorus was gaping, peristaltic activity was diminished or absent, and spastic phenomena were not observed, then the roentgenologist tended to suspect cancer and made his reports accordingly. The meniscus complex—a roentgenologic syndrome developed from the changes observed when ulceration occurs in a mass of neoplastic tissue excrescent on the surface of mucous membrane—continued to be a roentgenologic sign of neoplasm which is all but pathognomonic. When the roentgenologic evidence was equivocal, that is, when it was insufficiently clear to permit a reliable distinction between the two alternatives of benignancy and malignancy, then the more equivocal term "lesion" will appear in the roentgenologic reports.

The roentgenologic diagnosis is not considered to be definitive. It is offered by the roentgenologist as his best judgment about the existence, location, size, and probable pathologic nature of the abnormality before him and his clinical colleague accepts it as such and uses it as an aid—obviously the most important one he has—in determining the disposition of the problem as the following analysis of the roentgenologic diagnoses in this series of cases emphasizes so well.

TABLE VI.—ROENTGENOLOGIC DIAGNOSIS VERSUS SIZE IN SMALL GASTRIC ULCER AND SMALL GASTRIC CANCER REMOVED SURGICALLY IN THE YEARS 1940 TO 1945, INCLUSIVE

					Diameter of lesion													
	Total				Less than 1.1 cm.				1.1–2.0 cm.				2.1–3.0 cm.				3.1–4.0 cm.			
	Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma		Gastric ulcer		Carcinoma	
Roentgen diagnosis	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Negative	17	2.2	3	1.3	10	3.1	—	—	7	2.3	—	—	—	—	1	1.5	—	—	2	2.3
Duodenal ulcer only	72	9.3	5	2.3	51	15.9	1	5.6	10	3.3	—	—	5	4.9	—	—	6	12.2	4	4.5
Gastric ulcer	520	67.4	55	24.8	217	67.9	9	50.0	218	72.8	19	38.7	58	56.2	15	22.4	27	55.2	12	13.6
Lesion	123	15.9	80	36.0	31	9.7	6	33.3	49	16.3	16	32.7	32	31.1	30	44.8	11	22.4	28	31.8
Carcinoma	34	4.4	74	33.3	8	2.5	2	11.1	13	4.3	12	24.5	8	7.8	20	29.8	5	10.2	40	45.5
Other	6	0.8	5	2.3	3	0.9	—	—	3	1.0	2	4.1	—	—	1	1.5	—	—	2	2.3
Total	772	100.0	222	100.0	320	100.0	18	100.0	300	100.0	49	100.0	103	100.0	67	100.0	49	100.0	88	100.0

The changes employed by the roentgenologist in separating the benign from the malignant ulcer may be indistinct or even absent with considerable frequency among these small lesions and this often renders difficult the recognition of their pathologic nature. It is gratifying, therefore, to find in this series that when the diagnosis was gastric ulcer (575 cases), or gastric cancer (108 cases), the diagnosis was correct in 594 (86.9 per cent).

Analysis of data disclosed additional points of interest. When the roentgenologic diagnosis was gastric ulcer, the lesion was benign in 520 (90.4 per cent) and malignant in 55 (9.6 per cent, Table VI). It is probably not possible to increase the accuracy of this diagnosis much beyond 90 per cent, because the surgeon and the pathologist find about 10 per cent of small gastric cancers indistinguishable from gastric ulcer when examined grossly with the eye and the hand. The roentgenologist cannot be expected to recognize cancer when the distinguishing anatomic features of cancer are absent. When the roentgenologic diagnosis was gastric cancer, the lesion was cancerous in 68.5 per cent and benign in 31.5 per cent. This observation simply reflects the fact that benign ulcer mimics cancer in some cases, and reveals that the roentgenologic criteria used to distinguish between benignancy and malignancy of the stomach are not too reliable when they are applied to lesions which are small. The percentage accuracy of the diagnosis of small gastric cancer undoubtedly could be increased by reserving this diagnosis to those cases in which the "meniscus complex" is well developed. Doing so, however, would deprive the clinical consultant of valuable information, the experienced roentgenologist's best guess. In another 203 cases the roentgenologists simply said, "lesion." Of these 203 cases, 123 were benign and 80 (39.6 per cent) malignant.

The presence or the distinctness of roentgenologic features of cancer on which the roentgenologic diagnosis depends seemingly bears some relationship to the size of these small lesions of this series (Table VI). The percentage of benign ulcer called "cancer" increased from 2.5 to 10.2, and the percentage of cancer called "ulcer" decreased from 50.0 to 13.6 as the longest diameter increased from less than 1.1 to between 3.1 and 4.0 centimeters; that is, the larger the benign ulcer, the more frequently it simulated cancer, and the smaller the cancer the less frequently it presented features diagnostic of cancer. Similarly, the percentages of benign ulcer called "lesion" were 12.9 and 28.1, respectively, when the transverse diameters were less than 2.1 and 2.1 to 4.0 centimeters. It also appears that the larger the benign ulcer, the more frequently the roentgenologists found features suggestive enough of cancer to equivocate and diagnose "lesion." The percentages of small cancers in this group called "lesions" varied relatively little with size.

Duodenal ulcer. The only roentgenologic diagnosis in 77 of the 994 cases in which

roentgenologic examination was carried out was duodenal ulcer. In 39 of the 77 cases the duodenal ulcer was found by the surgeon, but in 37 of the 39 cases a gastric ulcer also was found, and in 2 a gastric cancer. Failure to recognize the intragastric lesion in the presence of a duodenal ulcer in these cases may be explained partly by focus of attention of the roentgenologist on the duodenal ulcer. In the remaining 38 cases a duodenal ulcer was not noted by the surgeon, but a gastric ulcer was found in 35 and a gastric cancer in 3. Failure in some of the 38 cases to locate the lesion correctly may be explained partly by its proximity to the pylorus in which event standard anatomic landmarks are often distorted or obliterated and orientation becomes a critical problem for the roentgenologist. In 27 of the 38 cases, the gastric ulcer was stated by the pathologist to be in the pyloric ring or within 1 centimeter of the pylorus. Failure to detect a gastric lesion stems from a variety of circumstances. Small size is certainly one of them since in 52 (67.5 per cent) of the 77 cases the longest diameter of the lesions was less than 1.1 centimeters. Ulcers so small are often shallow, too. The most significant factor, however, is pyloric obstruction of major or minor degree, which may be on the basis of actual organic constriction, or gastrospasm, more specifically pylorospasm, or both operating together.

The roentgenologist did not see the intragastric lesion in 20 of the 994 cases in which roentgenologic examination was carried out even though 2 or more such examinations were conducted in 8 of these 20 cases. In 8 of the 20 cases the gastroscopist saw the ulcerating lesion; in some of these cases the roentgenologist, suspecting an intragastric lesion, requested gastroscopic examination. In the remaining 12 cases the diagnosis was made at exploration. The clinical diagnosis in these 12 cases was indeterminate gastrointestinal bleeding in 5, gastrojejunal ulcer in 2, carcinoma of the pancreas (?) in 2, and cholecystic disease in 3 cases. Most of the 20 lesions were small, or located close to the pylorus. The longest diameter of 10 lesions was less than 1.1 centimeters and of another 7, 1.1 to 2.0 centimeters. The pathologist located 16 in relationship to the pylorus; in 8 the lesion was found in, or within 2 centimeters of, the pyloric ring. Another was just below the esophagogastric junction.

The discrepancy in this series between the numbers of duodenal ulcer reported by the roentgenologist and by the surgeon or pathologist is large. The roentgenologist reported duodenal ulcer in a total of 245 cases: in 221 (28.6 per cent) of the 772 cases of benign lesions and 24 (10.8 per cent) of the 222 malignant lesions examined by him. The surgeon found a duodenal ulcer in only 150 of these. In the 95 cases in which the surgeon did not record a duodenal ulcer, the roentgenologist may have seen the ulcer, but placed it on the wrong side of the pylorus. Or, the surgeon, his attention focused on the gastric lesion, did not search for or did not record the presence of a duodenal ulcer. The first possibility is suggested by the location of the gastric lesion within 1 centimeter of the pylorus in 50 per cent of the cases in which the lesion was located in a segment of the stomach by the pathologist. On the other hand, the surgeon found a duodenal ulcer in 203 cases (184 benign and 19 malignant); in 48 of these 203 cases (41 benign and 7 malignant) the roentgenologist did not see the duodenal ulcer. Again, the roentgenologist, his attention focused on the intragastric lesion, perhaps did not look for duodenal ulcer. The discrepancy between the numbers of duodenal ulcer found by the two groups of examiners may be narrowed by careful search for and recording of the lesions both by roentgenologist and surgeon.

Size of lesion. Incidence of malignancy in the gastric lesion varies so greatly with size that it is important to know the frequency with which the roentgenologist properly estimated the size. The roentgenologist simply estimated the size of the lesions; sometimes the size was expressed in centimeters and at other times the lesion was described

as small or large. It appears that the roentgenologist tended to underestimate the size of the small cancer more frequently than that of the benign ulcer. This is not surprising when it is recalled that the small cancer may be larger than its ulcerated area. When these small lesions, benign and malignant, were divided according to measurements made on resected specimens into those 2 centimeters or less, or more than 2 centimeters in diameter, the roentgenologist was found to have placed 70 per cent of the ulcerating lesions in the proper group. Exercise of greater care by the roentgenologist in his estimation of the size group in which the lesion will fall should lift this percentage, although obviously he cannot be expected to give breadth of microscopic involvement.

SURGICAL RESULTS

Surgical procedures and hospital mortality rates. Total gastrectomy was performed in 6, partial gastrectomy in 747, local excision and gastroenterostomy in 15, local excision in 9, segmental resection in 1, and gastroenterostomy in 1 of the 779 cases of benign ulcer surgically treated during the 6 year period 1940 to 1945, inclusive. The partial gastrectomy was of the posterior Polya type in 491, anterior Polya in 79, Hofmeister modification of the Polya operation in 92, Billroth I in 19, Billroth I (Schoemaker modification) in 64, Billroth II in 1 and transthoracic in 1 of the 747 cases in which partial gastrectomy was carried out for benign ulcer. The surgical procedures carried out for the 226 small gastric cancers during the same period have been listed in a previous report (2).

Hospital mortality rates, regardless of the surgical procedure, were 1.5 per cent for benign ulcer, and 2.7 per cent for small cancer. Hospital mortality rates after partial gastrectomy were 1.3 per cent for benign gastric ulcer, 1.8 per cent for small gastric cancer, and 0.5 per cent for benign gastric ulcer with duodenal ulcer. The risk of partial gastrectomy for small gastric cancer was not greatly different from that for gastric ulcer. It was, however, much less than that (6.4 per cent) for 830 partial gastrectomies carried out for gastric cancer of all sizes during the same period.

The dumping syndrome. Information about the dumping syndrome was obtained at return visits to the clinic, by questionnaire and by personal letters to the patient or his physician. Inquiry was made about each of the components of the syndrome, that is, epigastric distress, fullness or pain after eating, nausea, vomiting, weakness, sweating, and palpitation of the heart. Dumping was graded 0 to 3 according to its severity. In grade 0, no dumping was present; in grade 1, dumping occurred only after overeating and after certain foods; in grade 2, dumping was present in varying severity and duration after most meals but was less disturbing to the patient than his ulcer distress had been; in grade 3, dumping was so severe that the patient was unhappy over the exchange of dumping for his ulcer distress. It was not always possible in this group to judge whether incapacitation was due to the dumping, for among the incapacitated were those with profound exhaustion and psychoneurotic states, irritable bowel, and the like. The information recorded here pertains to the presence or absence of the syndrome 5 or more years after the operation.

Follow-up data regarding the existence of the dumping syndrome were obtained in 584 (75.0 per cent) of the patients with benign ulcer, of whom 53 are now dead. Comparable data were not obtained in 195, of whom 71 are now dead. Thus, follow-up data of this type have been obtained in 584 (82.5 per cent) of the 708 cases in which data had been or could be obtained at the time the survey was made in 1953 to 1954.

Symptoms suggestive of dumping did not, as would be expected, appear in the 8 cases in which local excision with or without pyloroplasty was performed, but it is of interest that 4 of 14 patients complained of dumping symptoms after gastroenterostomy and in 1 of the 4 the dumping was graded 3.

The postoperative dumping was graded 0 in 385 (68.9 per cent) of the 559 cases in which partial gastrectomy was done, 1 in 119 (21.3 per cent), 2 in 46 (8.2 per cent), and 3 in 9 (1.6 per cent). Of the 3 patients who had total gastrectomy, 1 had dumping, grade 3.

When the partial gastrectomies are classed according to the type of anastomosis, several points of interest were noted. All instances of grade 3 dumping occurred in the Polya group. The percentage incidences of grade 2 dumping were 6.8, 8.6, and 6.5, respectively, in the groups in which both anterior and posterior Polya anastomosis, the Hofmeister modification of both the anterior and posterior Polya, and the Schoemaker modification of the Billroth I procedures were carried out. These differences are not impressive. The percentage incidences of grade 1 dumping were 22.2 and 18.6, respectively, in those cases in which Polya operations both anterior and posterior and the Hofmeister modification of the anterior and posterior Polya procedures were performed, and 12.8 in those cases in which the Schoemaker modification of the Billroth I procedure was carried out. Similarly, the percentage of cases in which no dumping occurred was approximately the same (70.8 and 72.8) in the first two groups and higher (80.5 per cent) in the last group. The incidence of dumping appears to be less when the Schoemaker modification of the Billroth I procedure was done.

In the 427 cases in which anterior or posterior Polya procedures were carried out and follow-up data about dumping were obtained, the surgeon estimated that he had removed less than 50 per cent of the stomach in 10, 50 to 59 per cent in 164, 60 to 69 per cent in 181, 70 to 79 per cent in 38, and more than 80 per cent in 25 cases. In 9 cases he made no estimate. When the severity of the dumping was studied in relationship to the amount of stomach removed, the incidences of dumping, grades 0, 1, 2, and 3, respectively, were 68.0, 22.9, 8.6, and 1.7 per cent when less than 60 per cent of the stomach was removed; they were, respectively, 71.3, 19.3, 7.7, and 1.7 per cent when 60 to 69 per cent of the stomach was removed, and respectively, 57.1, 30.2 9.5, and 3.2 per cent when more than 70 per cent of the stomach was removed. In this series then the incidence of dumping increased when more than 70 per cent of the stomach was removed. The small number of cases did not permit analysis when other types of operative procedures were carried out.

Recurrent or anastomotic ulcer. In 14 (2.4 per cent) of the 584 cases of benign ulcer, in which follow-up data were obtained, the history, roentgenologic, or surgical findings permitted the assumption of, or confirmed the presence of, clinically important gastrojejunitis, gastrojejunal ulcer, or recurrent ulcer. These conditions developed in 1 case in which a healed duodenal ulcer as well as a gastric ulcer was present, in another in which the ulcer was partly in the stomach and partly in the duodenum, and in 12 cases in which only a gastric ulcer was noted by the surgeon. The development occurred as follows: after a Polya anastomosis (anterior or posterior) in 8 (1.9 per cent) of the 427 cases in which this type of operation was employed and follow-up data were available; after the Billroth I operation in 5 (8.2 per cent) of the 61 cases (the Schoemaker modification was employed in 47 of the 61 cases), and after gastroenterostomy plus excision in 1 case. Evidence for a recurrent or anastomotic ulcer was not obtained in any of the 70 cases in which the Hofmeister modification of the Polya anastomosis was used. The diagnosis was a presumptive one in 3 cases on the basis of one or more gross gastrointestinal hemorrhages, and in a fourth, because of a history of acute anemia; in 6 cases, the diagnosis was based on the symptoms and the roentgenologic diagnosis of ulcerative gastritis, gastrojejunitis, or jejunitis, and in 1 case on the x-ray diagnosis of jejunal ulcer. In 3 cases, vagotomy (1) or reresection (2) was performed for recurrent ulcer.

Survival rates following gastric resection. The 5 and 10 year survival rates are widely used indexes of the effectiveness of the treatment of cancer. It seems wise, therefore, to point out that the percentage of patients living 5 years after operation cannot rightly be identified as the proportion of patients cured, for the dual reason that individuals who survive that long may well die of cancer, and that all who die before that time have not necessarily succumbed to cancer. However, when the survival rates of these patients are considered in relationship to the survival rates of normal persons of the same age and sex, the resultant rate may be considered as adjusted for deaths not due to cancer. Five and 10 year survival rates may be used likewise as indexes of the effect of therapeutic procedures in other conditions.

Survival curves over a period of 10 years following surgical treatment of benign gastric ulcer and gastric cancer with diameters of 4.0 centimeters or less are shown in Figure 1. We were able to follow 725 (95.6 per cent) of the 758 patients with benign ulcers included in the series. (Excluded were the 12 hospital deaths and 9 foreign patients.)

The survival curve over the 10 year period for the benign series may be considered the same as that of a normal population of the same age and sex. In other words, except for the risk of operation, the patient's outlook for survival is that for the normal population. For the benign series the 5 year survival rate for the females was 96.6 per cent (114/118) as compared to 93.9 (570/607) for the males. The difference, 2.7 per cent, in favor of the females along with the rates themselves are similar to findings in the normal population.

The survival curve following gastric resection for small gastric cancers has been discussed previously (2). The 5 year survival rate following gastric resection for small gastric cancer (44.7 per cent) is about 40 per cent greater than that (31.6 per cent) for patients with gastric cancer of all sizes. Similarly, the 10 year survival rate (34.2) is also about 40 per cent greater than that

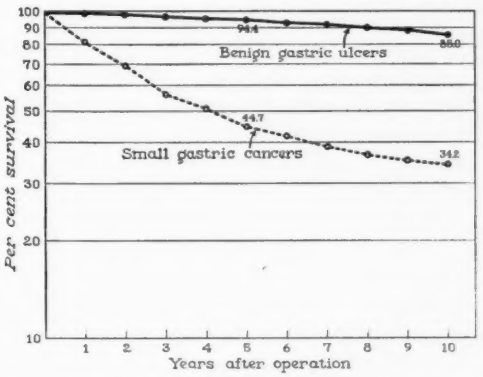

FIG. 1. Survival curves of patients with benign gastric ulcer and gastric cancer, whose greatest surface dimension was 4 centimeters or less, surgically removed during the years 1940 to 1945, inclusive.

(23.2) for patients with gastric cancer of all sizes. In the group of small gastric cancers the smaller the cancer the higher the survival rate. Thus, it was pointed out that the 5 year survival rate (71 per cent) for patients with gastric cancers whose greatest diameters measured 2.0 centimeters or less is more than twice as great as that for gastric cancers of all sizes, but the rate for patients with gastric cancers whose greatest diameter measured from 2.1 to 4.0 centimeters was not greatly different from the rate for gastric cancers in general.

The 5 year survival rates for patients with small gastric cancer given a roentgenologic diagnosis of gastric ulcer, gastric lesion, and gastric cancer, were, respectively, 60.0, 42.3, and 32.4 per cent. The favorable outlook for this total group of patients with small gastric cancer obviously depends to a great extent on the inclusion of the smaller lesions that appeared benign roentgenologically.

Surgical results. On the basis of the foregoing the results of surgical treatment of the 596 patients with benign gastric ulcer for whom the results are known may be considered unsatisfactory in 35 cases (5.9 per cent). These consisted of cases in which the patient did not survive the operation, or in which the patient had a disabling dumping

syndrome, grade 3, or an anastomotic or recurrent ulcer, or both. Results may be considered fairly satisfactory in the 44 cases (7.4 per cent) in which dumping, grade 2, developed and satisfactory in the 517 (86.9 per cent) in which no dumping or mild intermittent dumping, grade 1, occurred.

SUMMARY AND CONCLUSIONS

Certain data have been presented concerning 779 cases of benign gastric ulcer and 226 of gastric adenocarcinoma in which the greatest diameters of the lesions measured 4.0 centimeters or less and in which surgical treatment was carried out at the Mayo Clinic during the years 1940 to 1945, inclusive.

When the total group of patients with benign gastric ulcer was subdivided into those with (184 cases) and without (595 cases) duodenal ulcer, and data from the two groups were compared, distribution according to age, sex, size, location, and type of history was practically the same in the two groups. However, the percentages of cases in which more than 1 gastric ulcer was found were twice as large when a duodenal ulcer was present than when no duodenal ulcer was found. Histories also were longer, and gastric secretory activity was somewhat more pronounced.

Comparison of the 779 cases of benign gastric ulcer with the 226 cases of small gastric cancer surgically treated during the same years revealed some similarities and some important and at times striking differences. The sex incidences of the two groups were almost identical, and the frequency with which benign ulcers and small cancers occurred on the curvatures and walls of the stomach showed some variation.

The percentage of benign ulcers decreased and the percentage of cancers increased as size increased. Gastric ulcer was found with almost equal frequency in the lower (51.0 per cent) and middle thirds (47.0 per cent) of the stomach, but gastric cancer was found more frequently in the lower third (80.0 per cent) than in the middle third (17.8 per cent). The percentage of cases in which more than 1 gastric ulcer was found was 3 times as great as the percentage of cases in which more than 1 gastric cancer was found. Mean age of patients with benign ulcer (51.8 years) is about 4½ years less than that (56.1 years) of patients with small cancer. Although a majority of both the benign ulcers and small cancers had produced symptoms suggestive of ulcer, the benign ulcer group did this more frequently (88.5 per cent) than the malignant group (62.0 per cent). Although the duration of symptoms at the time of diagnosis and operation varied widely, there was a distinct trend toward longer duration of symptoms in the benign group. To illustrate, the percentage of patients with symptoms of more than 5 years' duration among patients with benign gastric ulcer (57.6) was about twice that of patients with malignant lesions (27.9).

Finally, the percentages of men (5.1) and of women (9.1) with benign ulcer whose gastric content did not contain free acid were much less than those for both men (24.6) and women (35.1) with small gastric cancer; mean free acidity of the remaining men with benign gastric ulcer (40.0 clinical units) is slightly higher than that (34.4 clinical units) among men with small gastric cancer. Moreover, the secretory activity in the cases of benign ulcer did not vary with size of lesion, but that of gastric cancer decreased with increasing size. It is of significance that gastric secretory activity in the cases of gastric ulcer and small gastric cancer, in which the longest diameter is 2.0 centimeters or less, is similar. These differences between the two sets of data permit determination of probabilities of malignancy based on age, sex, size and location of lesion, type and duration of symptoms, and gastric secretory activity which will be presented in another article.

Analysis of data emphasized that the roentgenologic differentiation of the small benign and malignant gastric lesion depends on the distinctness of the anatomicopathologic features. When these features are indistinctly

developed or absent, as they are not infrequently among this group of small lesions, the roentgenologist naturally will find it difficult or impossible to recognize the nature of the lesion. In this group of cases, when the roentgenologist said "gastric ulcer," cancer was present in about 10 per cent of the cases, that percentage of gastric ulcers in which the pathologist must resort to the microscope to decide the nature of the lesion. When the roentgenologist said "cancer," cancer was present in about 70 per cent of the cases; this percentage could be increased by reserving the diagnosis cancer to those cases in which the meniscus complex is fully developed, but the clinician prefers that the roentgenologist call the lesion "cancer" whenever the evidence in favor of cancer predominates. When the roentgenologist said "lesion," cancer was present in 40 per cent and ulcer in 60 per cent; thus reflecting the indistinctness of the anatomicopathologic features. In spite of the limitations of roentgenologic method in dealing with small lesions of the stomach, the roentgenologist correctly said "ulcer" or "cancer" in 87 per cent of cases in which he reported one of these two diagnoses. It is pertinent to remark that the roentgenologist does not send his diagnosis to the clinician, nor does the clinician receive the diagnosis in cases of the type under study as a microscopically confirmed one. The clinician or surgeon has the responsibility of using the information obtained by roentgenologic as well as by clinical and laboratory study in his final decision regarding therapy.

The surgical treatment of the 779 benign gastric ulcers was accomplished with an over-all hospital mortality rate of 1.5 per cent. The hospital mortality rate for partial gastrectomy for benign ulcer was 1.3 per cent. For the patients who survived the operative procedure the survival curve over a 10 year period was the same as that of a normal population of the same age and sex. An anastomotic or recurrent ulcer probably developed in 14 (2.4 per cent) of those 584 patients from whom suitable follow-up information was obtained and the dumping syndrome was present and disabling in 9 (1.6 per cent). The dumping syndrome was a constant problem in 46 (8.2 per cent), but these 46 patients were happy over the exchange of the dumping syndrome for the ulcer pain. Dumping was mild and intermittent, and related to the overloading of the stomach, or to the ingestion of certain foods in 119 (21.3 per cent) and was not present in 385 (68.9 per cent).

Surgical results were considered unsatisfactory in those cases in which the patient did not survive the operation, recurrent or anastomotic ulcer developed, or the dumping syndrome was disabling (5.9 per cent). They were thought only fairly satisfactory (7.4 per cent) when dumping was a daily problem, even though the patient was happy over the exchange of his ulcer symptoms for dumping. They were considered satisfactory in the remaining cases (86.7 per cent) in which dumping was absent or intermittent and mild. A healthy, happy patient with a normal life expectancy, free of morbidity from ulcer and assured that gastric cancer is not present in such a high percentage of cases is justification for surgical treatment of the benign gastric ulcer.

The surgical treatment of the 226 small gastric adenocarcinomas was accomplished with an over-all hospital mortality rate of 2.7 per cent. The risk of partial gastrectomy for small cancer (1.8 per cent in this series) is much less than the risk (6.4 per cent) of partial gastrectomy carried out in 830 cases of gastric cancer of all sizes during the same period at the Mayo Clinic. Life expectancy following operation, similarly, was far better for the small resectable gastric adenocarcinoma than for resectable carcinomas of all sizes. The 5 year survival rate following gastric resection for small gastric cancer (44.7 per cent) is about 40 per cent greater than that (31.6 per cent) for patients with gastric cancer of all sizes. Similarly, the 10 year survival rate (34.2 per cent) is also about 40 per cent greater than (23.2 per cent) for patients with gastric cancer of all

sizes. Moreover, in this group of small gastric cancers, the smaller the cancer the higher the 5 year survival rate. It was 71 per cent for those with gastric cancers whose greatest diameter measured 2 centimeters or less, whereas the rate for those with gastric cancer whose greatest diameter measured from 2.1 to 4.0 centimeters, inclusive, was 34 per cent. Most important, the 5 year survival rates following gastric resection in those cases in which a roentgenologic diagnosis was made of gastric ulcer, gastric lesion, and gastric cancer, respectively, were 60.0, 42.3, and 32.4 per cent. Survival rates are best in those groups most likely to be subjected to medical treatment. The small gastric cancer, a numerically large segment of resectable gastric cancers, often difficult to distinguish from benign ulcer, offers a better and more encouraging prognosis than resectable cancers in general. Another justification for surgical treatment of the apparently benign gastric ulcer is the fact that 33 (60.0 per cent) of 55 patients whose lesions were considered roentgenologically benign but proved to be malignant at operation were living and well 5 years later.

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THE VIABILITY OF PRESERVED BONE

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THE ESTABLISHMENT of bone banks has been the stimulus for a considerable amount of investigation as to the best method of preservation of bone. It is important to know the most favorable temperature, the most satisfactory media, and the optimum length of time a bone may be kept to obtain the most successful clinical result.

Many questions have arisen anew, which in the past were the subject of considerable controversy, as to whether a bone graft contributes any active temporary or permanent osteogenesis in itself; or only contributes some stimulating unknown factor to the surrounding or invading mesoblastic tissue or adjoining bone; or merely acts as an inert framework for new bone.

The present study is based on a premise established in 1922 (4) in which it was found that the inherent properties of the osteoblastic tissue of a fractured bone which caused it to unite when placed in muscle were the same as those found in its normal environment. It was also shown that if the two fragments of bone were boiled before being placed in muscle, no signs of union or bone proliferation took place (5). However, when one fragment was boiled and the other half was not, there was sufficient osteogenesis to unite the two pieces of bone.

In order to determine the importance of the periosteum and endosteum, another series of experiments was performed (6), in which the endosteum or the periosteum was removed before the two fragments were placed in muscle. Union took place if one or the other was allowed to remain, but if both were removed there was no union nor signs of bone proliferation.

By utilizing the same method in order to determine survival period of osteogenic cells, it was found in 1926 that bone kept at room temperature showed signs of proliferation up to 2 days, but if kept at near 5 degrees C., there were signs of proliferation up to 5 days (8). The shorter the exposure period, the greater was the reactive response (Fig. 1). At that time no thought was given to the bone bank, but these findings are of some significance in view of the present discussion relative to the preservation of bone.

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BONE REGENERATION

In order to appreciate more fully the problems under discussion, it is considered advisable to present some of the investigations regarding the fate of bone after transplantation into muscle.

Rhode, in 1925, concluded from his extensive investigations that metaplastic bone-building from the usual connective tissue of muscles, tendons, fascia, and subcutaneous tissues does not take place.

Levander stated that when bone was transplanted into muscle, the tissue around the bone forms the new bone. In his experiments he made a slightly acidified, 90 to 95 per cent alcohol solution of bone and callus. When this extract was injected into muscle, he obtained cartilage which was later transferred into bone. In some cases there was a direct formation of bone. As a control, when alcohol alone was injected there was no formation of bone.

Wilson (26) reported the results of transplantation of bone into the muscles of the back. Saw cuts that were made in these pieces of bone showed definite evidence of osteoblastic activity and tendency to repair in 3 weeks. Similar cuts in refrigerated bone took 6 weeks for the same degree of healing.

Key and associates found that autogenous bone chips placed in muscle showed a more

rapid uptake of radioactive phosphorus, given as a subcutaneous injection than did boiled or frozen bone. The investigators did not consider this observation as evidence of viability or that all free grafts are dead, but it corroborates the clinical impression that autogenous bone serves best the purpose of a free graft.

Ray and others found that after being introduced into the anterior chambers of the eye, homogenous grafts of embryonic bone and autogenous grafts of fractured callus, adult cancellous and cortical bone can survive in this simulated ectopic site. They also found that embryonic bone frozen at -18 degrees C. or lyophilized under a vacuum for 24 hours survived and grew when transplanted in an ectopic location. Fracture callus, adult cancellous bone, and cortical bone under similar conditions were less able to survive after this treatment.

In 1926, in somewhat analogous experiments, I (9) found that bone fragments placed in perforated rubber tubing, transplanted into joints showed definite callus and evidence of proliferation of bone.

Urist and McLean, in 1952, in their experiments on transplantation of periosteum, bone marrow, cancellous bone, cortical bone, fibrocartilaginous callus, epiphyseal cartilage, and articular cartilage into the anterior chamber of the eye, found that they all produced new bone. They believe that some of the elements of periosteum, bone marrow, cancellous bone, and fibrocartilaginous callus survive and proliferate following transplantation and give rise to new bone. Fibrocartilaginous callus devitalized by boiling or freezing with carbon dioxide, when transplanted to the eye produced new bone by induction into the cells of the host. This principle of induction follows the line of Spemann's theory of induction.

Ham and Gordon, in 1952, submitted autogenous bone chips to freezing in carbon dioxide ice for 10 minutes followed by thawing in warm saline solution, the process done 3 times. This method kills the cells of bone, but preserves all the chemical constituents. They transplanted one half of autogenous bone chips directly to muscle, while the other half was submitted to the thrice-freezing before transplantation. At the end of 5, 7, 21, and 28 days, pieces of each were removed for microscopic examination. In the fresh bone, healthy osteocytes could be seen at the edge of the bone chips close to the capillary supply and some new bone in association with the chips. In the bone treated by the freezing processes, there were no living osteocytes or bone proliferation about the chips. These investigators concluded that if bone formed about a transplant was due to metaplasia of the surrounding tissue, it should have formed about the freeze-treated chip as all the necessary elements were preserved except the living osteocytes. They maintain that the new bone that forms around untreated chips must come from the osteogenic cells or undifferentiated marrow cells that are in the bone chips.

Kiehn and Glover stored homologous grafts for from 30 to 143 days at +5 degrees C. and then allowed them to come to room temperature. One-half of the graft was boiled and placed in a pocket on one side of the chest wall, the other nonboiled half was placed on the opposite side. They then gave a dose of 300 millicuries of radioactive phosphorus. Both sets of grafts had the same ability to take up P^{32}, but less than autogenous grafts. The grafts at 51 days had the greatest ability to take up P^{32} while those at 143 days had the least.

Maatz, Lentz, and Graf performed experiments with plugs of cancellous bone, which they call the spongiosa test. A plug of cancellous bone is removed from the tibia or femur and replaced by an autograft, a homograft, or a heterograft of the same size. They concluded that autografts regenerate from their own power, and that homografts are dependent on the osteogenic power of the host and take twice as long for their replacement as autografts. Heterografts act to a considerable extent as a foreign body and take 3 times as long for replacement as

autografts. It is their opinion that the evidence of formation of bone in transplantation to muscle or to the anterior chamber of the eye appears late and in clinical practice plays a minor role in the fate of an implanted graft.

BONE PRESERVATION

Inclan, in 1942, reported his clinical results on the use of bone preserved in citrated blood at 2 to 5 degrees C. He obtained good results with autogenous and homogenous bone that had been preserved from 2 to 63 days. He claimed there was no difference histologically between preserved and fresh bone but admitted the superiority of fresh autogenous bone.

Leonard Bush and others, in 1947, stated that bone may be preserved at 2 to 5 degrees C. and autogenous frozen, at —24 degrees C. for 7 days. Less successful in order of their value were homogenous fresh, homogenous frozen, and autogenous boiled. They stated that human bone could be preserved indefinitely at —20 to —30 degrees C. Microscopic studies showed that the transplanted bone died and was surrounded by connective tissue undergoing metaplasia and new bone formation.

Weaver, in 1949, stored bone in deep freeze at —40 degrees C. using dry ice. Later he kept it at —20 to —25 degrees C. using no preservative. He used this bone up to 308 days. Massive grafts were not as successful as small grafts, and he thought cadaveric bone was better than bone from operations.

Reynolds and Oliver (19) reported that merthiolate bone was just as good as other bone for use in transplantation. In another series of experiments they implanted autogenous, homogenous, merthiolate, deep freeze bone at —20 degrees C. and boiled bone into the tibia of dogs. They found very little difference between any of these except boiled bone, and although there was an earlier response in autogenous bone, it did not in itself contribute any osteogenesis. In an article (20) in 1951, they decided their clinical results with merthiolate bone were not as good by a considerable margin as with autogenous bone. They also concluded that some of the cells of an autogenous graft are capable of survival and instigating the process and thus accelerating it when the host capillaries reach the graft.

FIG. 1. Photomicrograph of a fractured bone that was kept at 5 degrees C. for 3 days and then transferred to the muscles of the back of the same animal. *a-a'*, original bone with stainless nuclei; *c-c*, new osteoid callus connecting the two fragments of bone.

Kreuz, in experiments in which lyophilized grafts were put in the radii of dogs, found that they were incorporated in the same manner as fresh autogenous grafts, but at a slower rate. The freeze dry bone was somewhat superior to frozen bone in regard to healing in the earlier phases.

Wilson (25) found that autogenous grafts exhibited some advantages over refrigerated grafts in that healing took place more rapidly, but in the end the results were the same. Both human autogenous and refrigerated grafts showed no difference in rate of repair, but transplants preserved over a year did not heal as well as grafts preserved for a short time.

Herbert used grafts that were put in glycol and water, then submitted to a temperature of —35 degrees C., after which they were stored in a refrigerator at +5 degrees C. He claims he obtained excellent results in practically all clinical applications necessitating a graft of bone.

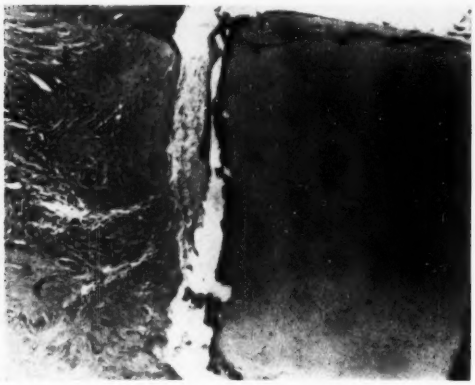

FIG. 2. Fractured bone preserved in homologous serum for 2 days at 5 degrees C. and then buried in muscles of the back for 31 days. No viable cells or signs of proliferation.

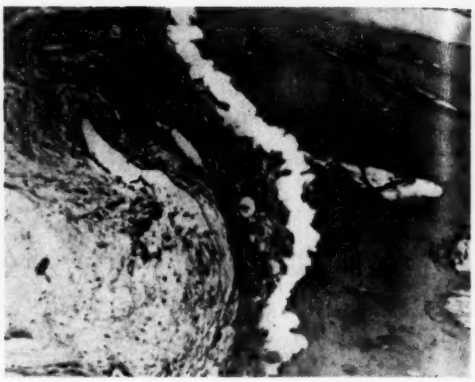

FIG. 3. Fractured bone preserved in homologous serum for 7 days at 5 degrees C. and then buried in the muscles of the back for 32 days. No evidence of proliferation. The osteocytes appear to be dead.

Campbell and associates anchored grafts into the outer cortex of the ribs. They found that in fresh autogenous grafts, the osteogenesis of the graft took part in incorporating the graft to the host tissue. Homologous, frozen autogenous, and homogenous bone at —30 degrees C., os purum, and boiled bone acted as foreign bodies as evidenced by the fibrous tissue and osteoblastic activity about the graft.

Bosworth, in his operations, found that there were 3 times as many pseudoarthroses with bank bone as with autogenous fresh bone. In the repair of pseudoarthroses there were 3 times as many failures as with fresh bone.

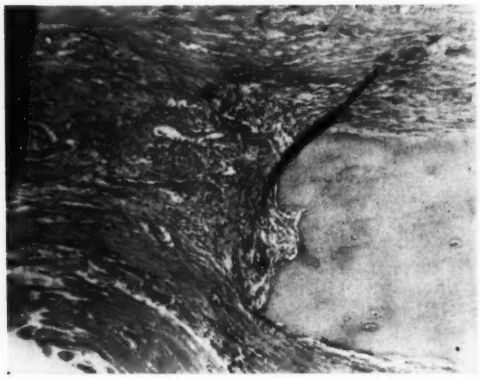

FIG. 4. Fractured bone preserved in homologous serum for 7 days in deep freeze near —30 degrees C. and then buried in muscle. No signs of proliferation. Only a few osteocytes are present in the bone.

Tucker preserved bone in human plasma to which he added 3 grams of sodium sulfathiazole and 1,000,000 units of soluble penicillin to each 1,000 cubic centimeters. The containers were kept at 5 degrees C. Fixed sections of human bone which had been in plasma for 28 months showed the structure of bone comparable with fresh bone. Bone stored by freezing for 1 week showed very poor structure and only a few osteocytes. He also tested the viability of bone according to the method of Cappell. In this method the nucleus and cytoplasm of healthy living cells do not become stained when exposed to supravital stains, the cells possessing sufficient viability to differentiate the dye. On the contrary, in dead or injured cells the granules and nuclei are stained. He found by this method that cells stored in human plasma were viable after 28 months. In later investigations, he found that the longer bone is preserved in plasma, the greater the amount of fibroblastic proliferation there is on the surface, and in consequence of this a more rapid union takes place with the recipient. A graft that was preserved for 18 months united more rapidly than a graft preserved for 2 weeks. Tucker's

FIG. 5. Fractured bone preserved in autogenous serum at 5 degrees C. for 6 days and then buried in the muscles of the back. There is slight proliferation at the fractured surface. There is some endosteal proliferation.

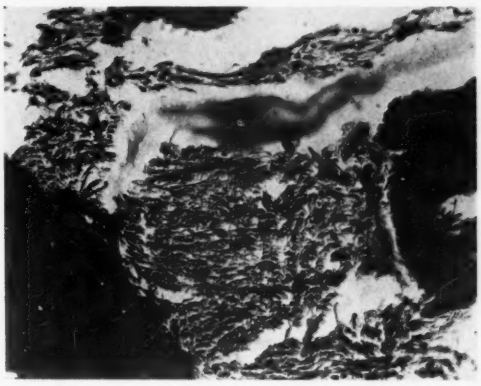

FIG. 6. Fractured bone preserved in autogenous serum at 5 degrees C. for 11 days, and then placed in muscles of the back. There is some new bone on one side between the fragments.

work was the stimulus for the present study on the viability of bone preserved in different media, at variable temperatures, and different periods of time.

Bone preserved in homologous serum at 5 degrees C. This group of experiments consisted of preserving fragments of fractured bones in homologous serum to which were added 3 grams of sulfathiazole and 1,000 units of penicillin for each 1,000 cubic centimeters. The pieces of bone were taken from portions of the shafts of metacarpal bones. They were placed in the homologous serum and kept at a temperature of about 5 degrees C. At the end of the desired period of time, the fragments were tied together and buried into the muscles of the back. At the conclusion of the experiments the specimens were removed and sections prepared for microscopic study.

There was no evidence of proliferation of bone after 2 days (Figs. 2 and 3). These findings are in marked opposition to those of Tucker who reported survival of bone after many months. It is to be noted that he used plasma in most of his experiments because of its availability.

Bone preserved in homologous serum at —30 degrees C. A similar set of experiments was performed in which the fragments of bone were kept in the deep-freeze at about —30 degrees C. before transferring them to muscle.

There was no evidence of proliferation of bone in any of the experiments. An occasional viable apparing osteocyte was seen in the bone (Fig. 4).

Bone preserved in autogenous serum at 5 degrees C. In order to determine if there was any difference between homologous serum and autogenous serum, the fragments of bone were placed in autogenous serum at 5 degrees C. After variable periods of time, the bone so preserved was transferred to the muscles of the back from the same animal. There were some signs of proliferation of bone in 1 experiment after a lapse of 11 days (Figs. 5 and 6).

These experiments show that autogenous serum is a better media than homologous serum for preservation of bone.

Bone preserved in autogenous serum at —30 degrees C. In this set of experiments the bone, after being placed in autogenous serum, was kept at —30 degrees C. There was no evidence of viability of bone in any of these experiments.

Bone preserved in citrated homologous blood at 5 degrees C. Whole citrated blood has been successfully used in clinical cases. In order to determine if there is any superiority of bone so preserved over other methods, a set of

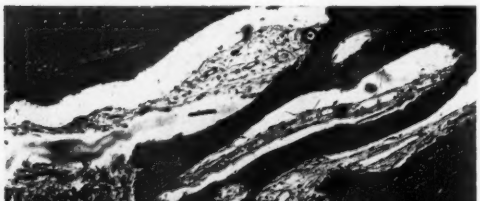

FIG. 7. Fractured bone preserved in citrated homologous blood at 5 degrees C. for 11 days and then transferred to the muscles of the back. There is active bone proliferation between the fragments.

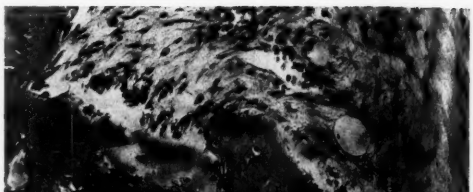

FIG. 8. Fractured bone preserved in homologous blood at 5 degrees C. for 14 days and then placed in the muscle. Active new bone proliferation between the fragments of bone.

experiments was performed in which the fragments of bone were kept in citrated homologous blood at 5 degrees C. After different periods of time the pieces of bone were held in contact with each other and placed in the back muscles.

Evidence of bone proliferation was found up to 14 days and the active response was more uniform than in any other method of preservation (Fig. 7). These findings indicated that whole citrated homologous blood at 5 degrees C. was the best preservative medium for bone.

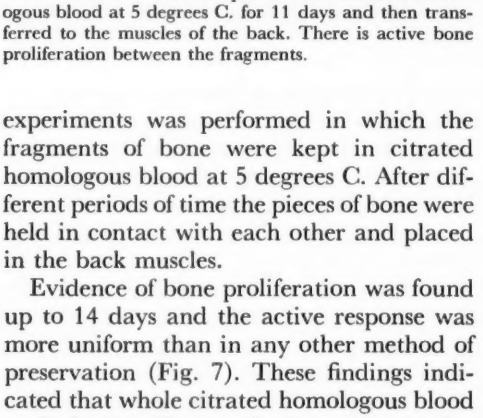

FIG. 9. Fractured bone subjected to quick freeze after which the fragments were placed in the muscles of the back. No signs of viability of proliferation.

Bone preserved in homologous citrated blood at —30 degrees C. The bone fragments were placed in homologous whole blood and kept at —30 degrees C. before transplantation to the muscles of the back.

In the few experiments there was slight evidence of proliferation of bone. It has been a uniform observation that the viability of bone was lessened at the low temperature of —30 degrees C.

Simultaneous test of autogenous and homologous whole citrated blood at 5 degrees C. In order to compare autogenous and homologous citrated blood as a preservative media, fragments of bone were removed from the same animal. One set was placed in autogenous blood and the other set in homologous blood at 5 degrees C. At the end of the same period of time the pieces were held together and placed on opposite sides of the muscles of the back in the same animal for a like number of days.

There were more active signs of proliferation of bone from the homologous preserved fragments of bone than from the autogenous preserved fragments. There was also a longer period of survival in the bone preserved in homologous blood. Signs of proliferation were found at 14 days in the bone preserved in homologous blood (Fig. 8).

Comparative test between autogenous whole blood and homologous whole blood at —30 degrees C. The fragments of bone in one group were preserved in autogenous blood and in the other in homologous whole blood at —30 degrees C. for the same number of days. After the allotted time, the fragments were tied together and placed in the muscles on opposite sides of the back.

At the end of 10 days there were only a few viable cells in the bone preserved in homologous blood, but none in the bone preserved in the autogenous blood. This observation again showed the lessening of the osteogenic activity of the osteocytes when preserved at a temperature of —30 degrees C.

Quick freeze method for preservation of bone. In view of the successful use of bone for transplantation that has been preserved by the quick freeze process, some experiments were performed with the bone fragments treated by this method. After being subjected to the quick freeze process, the fragments were placed together and inserted into the muscles of the back.

There was no sign of bone proliferation or viability of the osteocytes. Furthermore, there was no evidence of metaplasia of bone in the surrounding tissue (Fig. 9). Quick freeze is only a method of preserving dead bone for availability when needed, but the inherent osteogenic properties of live bone are lacking.

SUMMARY

1. Bone preserved in homologous serum at 5 degrees C. for varying periods of from 2 to 32 days showed only slight proliferation at the end of 2 days after transplantation to muscle.

2. Bone preserved in homologous serum at —30 degrees C. possessed no signs of viability after transplantation to the muscles of the back.

3. Bone preserved in autogenous serum at 5 degrees C. showed only slight endosteal proliferation at the end of 11 days.

4. Bone preserved in autogenous serum at —30 degrees C. exhibited no signs of viability after transplantation.

5. Bone preserved in homologous citrated whole blood for 15 days at 5 degrees C. showed definite signs of proliferation after transplantation to muscle.

6. Bone preserved in homologous whole blood at —30 degrees C. for 4 days showed slight proliferation after transplantation.

7. Bone preserved in autogenous whole blood at 5 degrees C. for 11 days exhibited minimal signs of proliferation after transplantation to muscle. The response was considerably less than with the bone preserved in homologous whole blood.

8. Bone preserved in autogenous blood at —30 degrees C. showed no signs of proliferation or viability after transplantation to muscle.

9. Bone subjected to the quick freeze process produced no proliferation of or metaplasia about the fragments after transplantation to muscle.

CONCLUSION

From this series of experiments one may conclude that bone preserved in citrated blood possesses the longest survival period of osteogenic cells and exhibits the greatest power of proliferation of these cells. Bone preserved in autogenous blood showed less sign of osteogenesis than the bone kept in homologous blood.

A temperature of about 5 degrees C. was the optimum temperature for preservation of osteoblastic activity. A temperature approaching —30 degrees C. inhibited osteogenic activity of the transplanted bone. There was a decrease in osteogenesis and viability with increase in time of preservation. Serum did not serve as a good preservative medium for bone. Autogenous bone when used at once offers the greatest chance for a successful result whenever it is necessary to use a graft of bone.

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CORONARY ARTERIOGRAPHY IN ARTERIOSCLEROTIC DISEASE OF THE HEART

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GREAT ADVANCES in precise diagnosis and definitive therapy have followed the development of cerebral arteriography, aortography, and arteriography of the extremities. The blood vessels of the heart, however, have not yet been studied in coronary sclerosis of the living human, although coronary arteriograms have been obtained incidental to retrograde aortography. Present day knowledge of the natural history of coronary artery disease is derived largely from circumstantial evidence in the living patient, or from postmortem studies which frequently represent the end state of a disease process. In no other field are the results so confusing and difficult to evaluate as in the surgical treatment of coronary artery disease. Substantial clinical benefits have been claimed from procedures which, at least superficially, appear to have questionable merit. An objective evaluation of the state of the coronary system prior to surgery is therefore necessary. The present study will outline the technique we have used in applying arteriography successfully in several cases of advanced arteriosclerotic cardiovascular disease. The application of this work to precise diagnosis, and possibly to surgical therapy, will be discussed.

METHOD

Coronary arteriograms were first performed on patients receiving intra-arterial nitrogen mustard therapy for advanced metastatic malignant disease. The injection of dye was done under general anesthesia, the catheter being maneuvered first into the ascending aorta for the coronary arteriogram and then into the descending aorta for nitrogen mustard injection. The age range of this group of patients was from 17 to 76 years. The procedure was so well tolerated in this group that we were encouraged to apply it to patients with coronary artery disease. We have now performed 18 coronary arteriograms. In 3 patients the catheter could not be maneuvered into the ascending aorta and the studies could not be completed. All of the patients with clinical coronary artery disease have been carefully evaluated preoperatively. These detailed studies will be the subject of another report. Initial studies were made under general anesthesia and were well tolerated. Subsequently the procedure was done regularly under local anesthesia without untoward event. The patients were given 50 milligrams of dramamine and 25 milligrams of phenergan intravenously 30 minutes before the injection of contrast material, and 1/100 grain of atropine intravenously 10 minutes before the procedure. The brachial artery was exposed about 2 inches below the posterior axillary fold after the entire area had been infiltrated with 1 per cent procaine. An arteriotomy, 0.5 centimeter in length, was made and a No. 10 French thin-walled Lehman cardiac catheter threaded through the brachial artery. Under fluoroscopic control with the image intensifier, the catheter was easily maneuvered into the ascending aorta in most instances. A right-sided approach has

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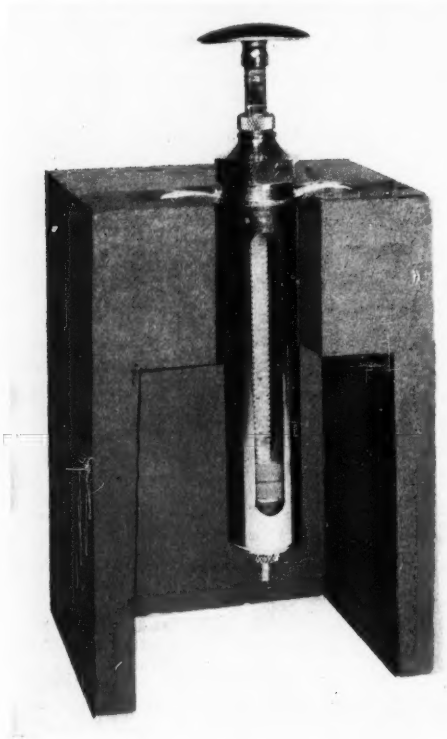


FIG. 1. Simple wooden injection block to allow rapid injection of dye.

been used thus far. At the conclusion of the procedure, the brachial artery was carefully resutured.

Our initial studies in dogs, and subsequent experience in humans, have confirmed the idea that the ideal position for the tip of the catheter was about 2 inches above the sinus of Valsalva. We have used several radiopaque media in animals and humans. In the last 12 cases renografin 76 per cent has been used and has so far proved satisfactory for this purpose. We have generally injected 40 cubic centimeters of renografin in a period of 1.5 seconds using the simple injection block illustrated (Fig. 1). The Rigler-Watson rapid film changer was used to obtain the radiographs. Five exposures per second were made. It is important to study multiple films taken over a short interval in order to demonstrate the entire course of the coronary arteries. Exposure factors used were 400 or 500 milliamperes, 95 kilovolts at 1/30 or 1/60 of a second. Throughout the procedure the patient's electrocardiograph was monitored, and during the immediate injection phase the carotids were compressed bilaterally. It should be emphasized that a trial of bilateral carotid compression prior to injection is necessary to identify patients with abnormally sensitive carotid sinus reflexes. Recently we have prepared some patients with coronary disease by giving 1 gram of pronestyl about 3 hours prior to the x-ray study.

To date, reactions of any consequence have not been encountered after injection of the contrast material. The patients have had a fleeting sensation of warmth, and a few have noted a momentary bitter taste on the tongue. It should be noted that the cerebral circulation of radiopaque material was diminished by carotid compression.

REPRESENTATIVE CASES

Advanced coronary atherosclerosis

CASE 1. This 72 year old white male patient had a large carcinoma of the rectum with widespread metastases. Blood pressure was 120/80 and electrocardiogram revealed atrial fibrillation and nonspecific T-wave changes. There were no complaints referable to the cardiovascular system. The coronary arteriogram (Fig. 2) showed marked tortuosity of all the peripheral coronary vessels and multiple arteriosclerotic plaques could be delineated. The vessels were irregularly ectatic with the formation of minute aneurysmal dilatations.

Essential hypertension

CASE 2. This 65 year old white male complained of headache, recurrent fainting spells, and dizziness. Examination of the cardiovascular system demonstrated only a prominent left ventricle and left axis deviation of the electrocardiogram. Blood pressure was 200/120. The coronary arteriogram (Fig. 3) showed large coronary vessels. In multiple films the progression of the dye from the origin to the periphery of both right and left coronary arteries could readily be seen. Patent anterior descending and circumflex branches on the left and a large right coronary artery were seen.

CASE 3. This 55 year old man had a pneumonectomy for carcinoma of the left lung in 1954 and re-

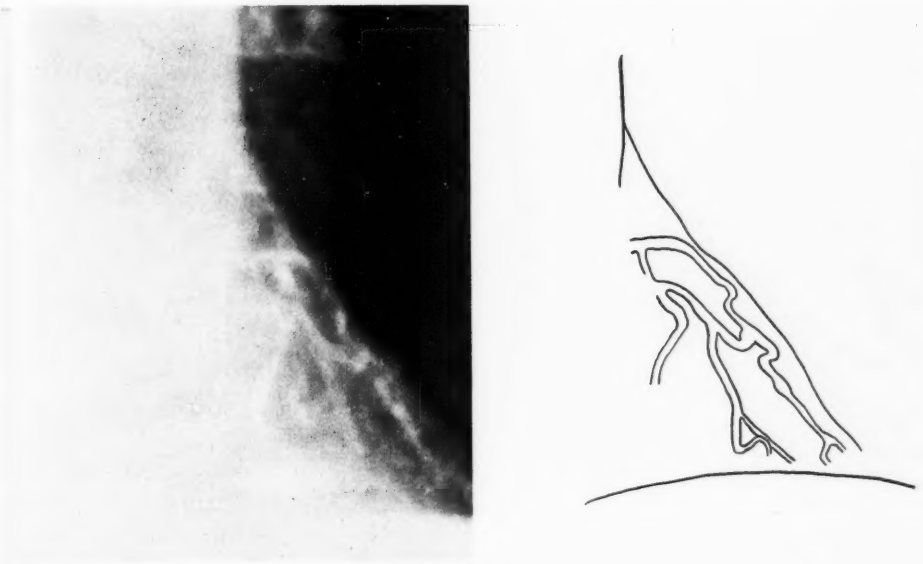


FIG. 2.

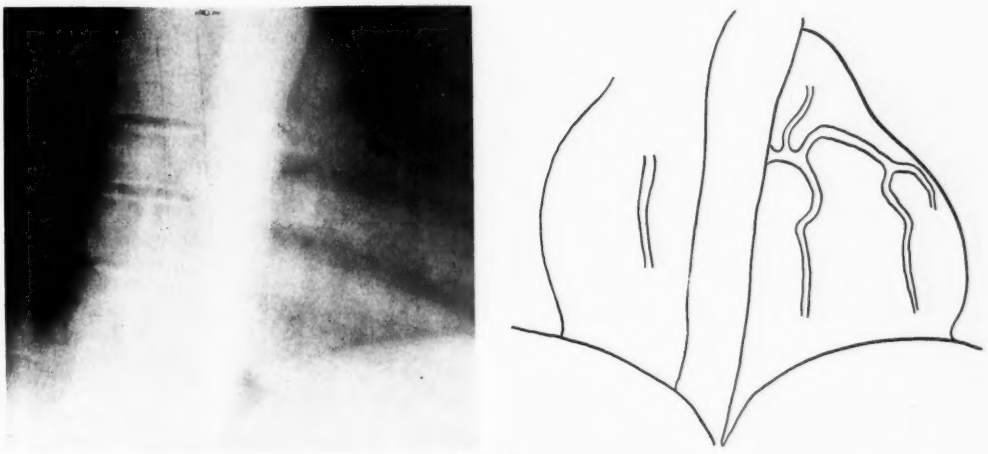
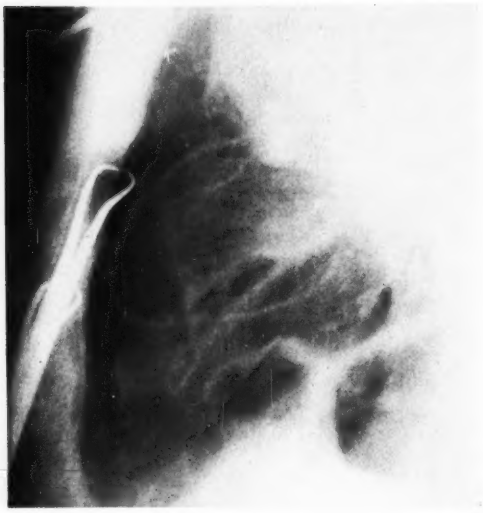


FIG. 3.

FIG. 2. Markedly tortuous anterior descending and circumflex branches of the left coronary artery are seen. Multiple calcific plaques and irregularly ectatic areas can be visualized.

FIG. 3. One of a series of films demonstrating an essentially normal coronary artery system. The left coronary artery and its branches are shown in considerable detail. The right coronary artery, which is not clearly seen in this film, except for a small segment, was better delineated on other films of the series.

entered with complaint of chest pain which was questionably related to effort, but certainly not typical for angina pectoris. Electrocardiogram revealed nonspecific S-T and T wave changes which were interpreted as being compatible with myocardial ischemia. As there was a complete fibrothorax on the left side, the patient was positioned in the full lateral projection. Coronary arteriography in this position, as can be seen from the reproductions in Figure 4, was particularly advantageous for investigation of the right coronary artery. Both the right coronary and the anterior descending branch of the left coronary artery



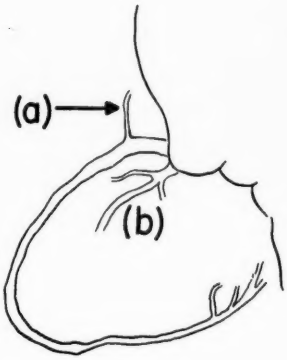
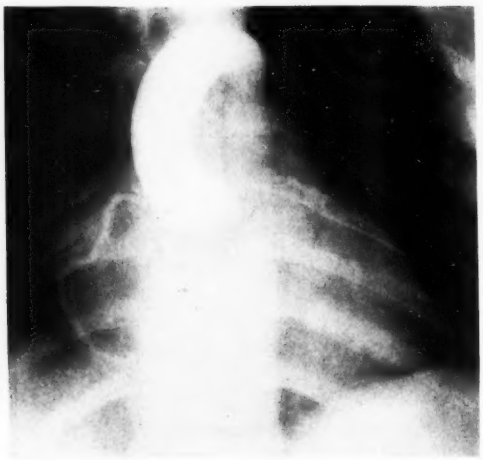


FIG. 4.



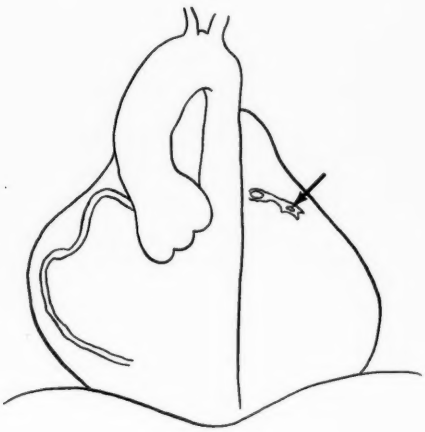


FIG. 5.

FIG. 4. Lateral projection shows the right coronary artery in detail. The cardiopulmonary branch is clearly demonstrated (*a*). The anterior descending branch of the left coronary artery is also seen (*b*).

FIG. 5. Multiple partially occluding plaques are seen in the left main coronary artery with complete obstruction in the anterior descending branch.

FIG. 6. A portion of the collateral supply around the obstructed left coronary artery is seen in this film. The right coronary artery fills well but multiple plaques are present. The arrow indicates an area of partial occlusion from which the section illustrated in Figure 7 was taken.

FIG. 7. Sections of the coronary arteries from Case 4. a, A section of the right coronary artery showing intimal proliferation, taken at the point of narrowing marked on Figure 6. b, A section of the anterior descending coronary artery taken immediately distal to the point shown in Figure 5. The vessel is completely obstructed by organized thrombus.

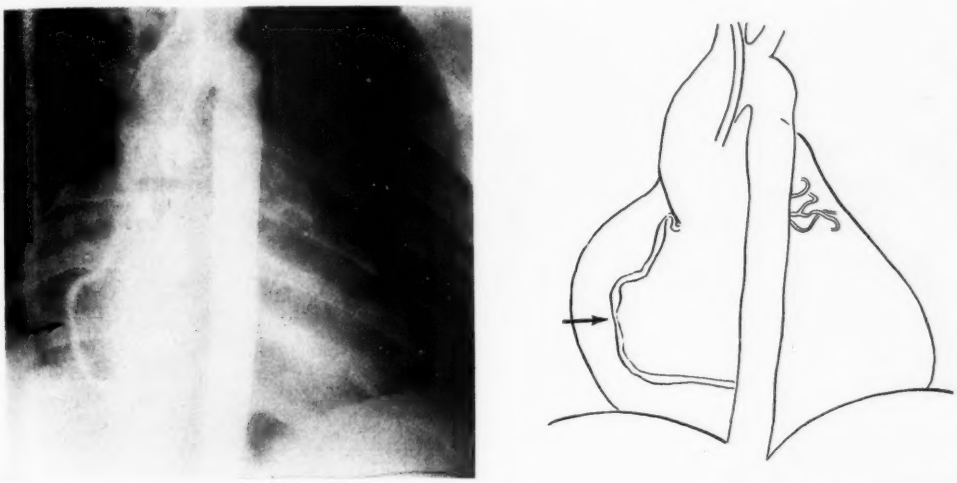
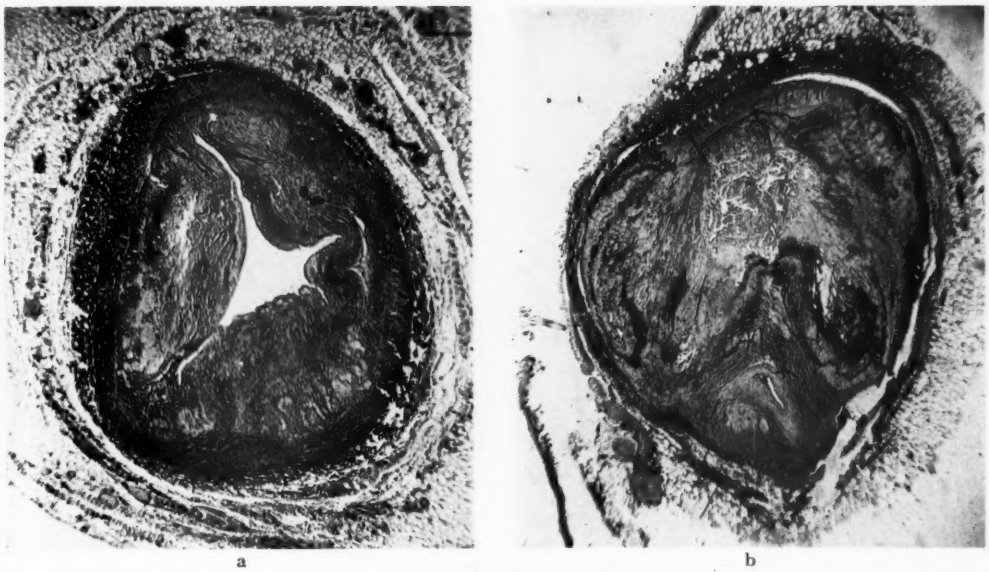


FIG. 6.



a b

FIG. 7.

(Legends on facing page.)

could be seen in complete detail. There were no abnormalities. It is of some interest that a cardiopulmonary branch could be seen arising from the right main coronary artery and travelling to the region of the undivided pulmonary artery. Such a vessel might be of considerable importance in the formation of collateral channels after coronary occlusion.

Occlusive coronary artery disease with angina decubitus

CASE 4. This 43 year old white male patient had had severe substernal crushing chest pain on exertion for over 10 years. Over the past year the pain had become increasingly burdensome and was only partially relieved by approximately 20 to 25 nitroglycerin tablets daily.

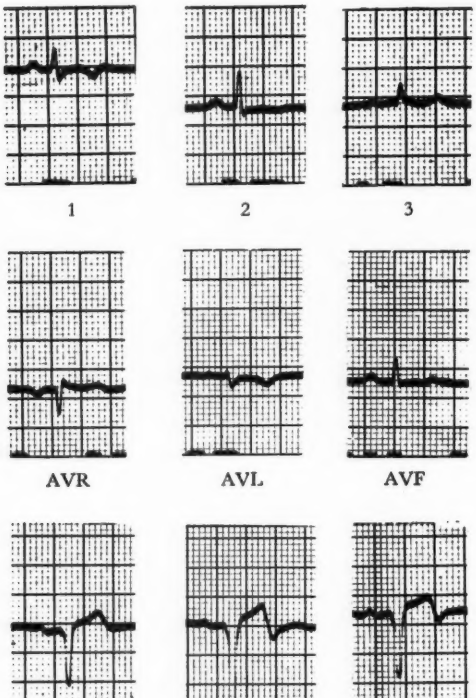


FIG. 8.

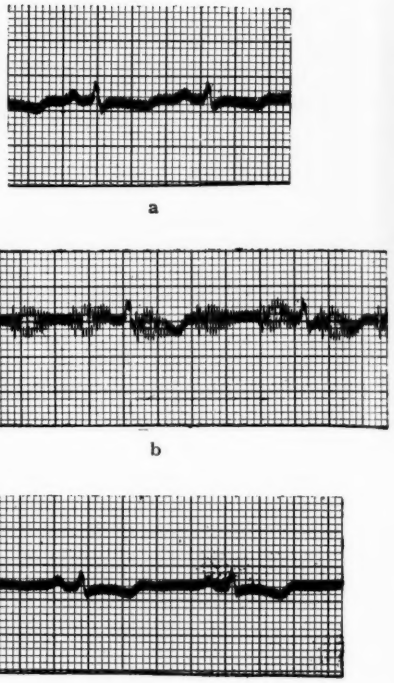


FIG. 9.

FIG. 8. Electrocardiogram in Case 4, demonstrating evolving anterior myocardial infarction.

FIG. 9. Patient in Case 4 monitored with electrocardiogram during injection of opaque material. Lead 1. a, Before injection. Depressed S-T segments, inverted T waves; rate, 75 per minute. b, During injection. No change in S-T segments; 60 cycle interference, rate, 60 per minute; slowing coincidental with injection and bilateral carotid artery compression. c, Three minutes after injection. Depressed S-T segments; inverted T-waves; rate, 95 per minute.

Within the last few months he had experienced angina while in bed. There was no clear-cut history of an episode of acute myocardial infarction. Electrocardiograms demonstrated a large anterolateral myocardial infarction (Fig. 8). An electrocardiogram is also shown taken during the period of injection of contrast material (Fig. 9). It may be seen that there was no significant change during or after this injection. Coronary arteriography in this patient was particularly revealing (Figs. 5 and 6). The large right coronary artery was obvious and could be traced out in successive films to the terminal posterior descending branches. Although this vessel was large, several constricted areas and arteriosclerotic plaques could be readily made out. There were partial multiple occlusions of the proximal 2 centimeters of the left main coronary artery. There was also considerable collateral blood supply in this area. Judging from the serial films, it appeared that blood reached the proximal portion of the anterior descending coronary artery at a slightly later period and tended to stagnate in this area for longer than in other parts of the heart. Distal to this point, there was an extensive area of calcification, and the anterior descending branch was seen to be con-

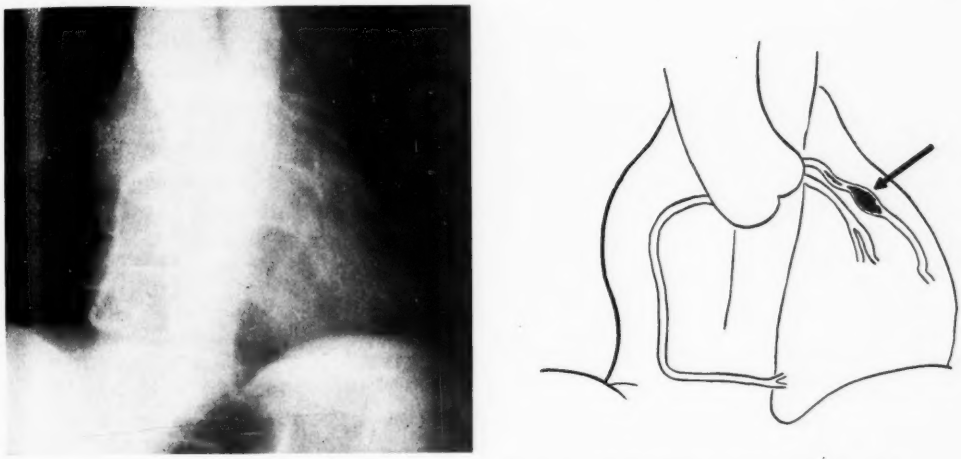


FIG. 10. Case 5. An area of marked narrowing due to an arteriosclerotic plaque can be seen in the anterior descending branch of the left coronary artery. The left circumflex and right coronary vessels are also shown.

pletely obstructed. Moreover, no retrograde filling was seen in the area of the left ventricle. The main blood supply to this heart was quite obviously through the right coronary system. However, even in this large vessel several arteriosclerotic plaques could be made out. In spite of the fact that this patient was a bad risk, he tolerated the procedure well. We believed that the anterior descending artery, distal to the site of obstruction, might be patent, and in view of the severity of angina in this young man, an attempt was made at direct anastomosis of this vessel to the internal mammary artery in the same manner as had been previously reported in dogs (2). The patient tolerated anesthesia uneventfully, and it was found that the major portion of the anterolateral aspect of the left ventricle was composed of white scar tissue surrounded by a 2 centimeter fringe of deeply cyanotic myocardium.

The anterior descending artery was divided distal to the point of occlusion shown on the x-ray film, but it was found that there was no blood flow in this artery in either direction, although a small lumen was present. The arterial wall in this patient was extremely friable, and it was not possible to find any tissue suitable for direct anastomosis, although the artery was traced out to the apex of the heart. No arterial bleeding was encountered from the surrounding myocardium. Accordingly, the internal mammary was implanted into the myocardium by the method of Vineberg. The patient tolerated this procedure well and appeared to be doing satisfactorily. Immediately after extubation, he developed cardiac arrest. The chest was rapidly reopened and heart action easily restarted. However, it was noted that only the right ventricle was capable of a forceful contraction. The left ventricle, made up almost entirely of scar tissue, was able to sustain only an extremely weak beat. Postmortem examination of the heart of this patient revealed the complete accuracy of the coronary arteriogram.

Stenosis of the anterior descending coronary artery

CASE 5. This 60 year old man complained of chest pain which was not clearly of anginal nature. Electrocardiogram was entirely normal. Coronary arteriogram, shown in Figure 10, again demonstrated a large right coronary artery and partial occlusion of the anterior descending artery. However, the distal artery filled well and symptoms could not be explained on the basis of myocardial ischemia. Nevertheless, the site of stricture of the anterior descending artery is of great interest, and subsequent study may show further occlusion at this point at a later date. The stenotic area appeared to be located at the site of choice for the early development of coronary occlusion.

DISCUSSION

In 18 consecutive coronary arteriograms, including patients with arteriosclerotic cardiovascular disease, there have been no adverse effects attributable to the procedure. Local anesthesia has been used in the last 12 patients and this would appear to be the procedure of choice. In our experience, the procedure has so far proved safe. It is tech-

nically easy, and with correct positioning of the catheter and rapid injection of the opaque medium, detailed arteriograms can be expected regularly. From the surgical standpoint, this technique has great potentialities both in the selection of patients for surgical treatment and in demonstrating the type of surgical procedure best indicated. In addition, the method holds promise for both diagnosis and prognosis in difficult clinical cases. If the initial promise of this method is upheld, it may yield considerable information concerning the early development and natural history of coronary atherosclerosis.

SUMMARY

A technique is described for coronary arteriography in the human patient. At the time of writing, 18 patients have been examined without complication. Five cases, in which coronary artery disease was suspected, are described in detail. A case of a patient with complete occlusion of the anterior descending coronary artery as well as partial occlusion of the right coronary artery is illustrated. The application of the technique, which has been described, to the more accurate diagnosis of coronary artery disease is discussed.

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SQUAMOUS CELL CARCINOMA OF THE ESOPHAGUS

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IN RECENT YEARS, the authors of reported series of squamous cell carcinoma of the esophagus have been decidedly pessimistic when considering the survival rates. Resections of these lesions represent considerable investment from the standpoint of both the patient and the surgeon, and if the results are to be so poor that a 5 year survivor is a rarity, then other forms of therapy should be sought. In Ochsner and DeBakey's exhaustive survey in 1941, they collected statistics from 1,025 autopsies on patients who had died of carcinoma of the esophagus and found that 40.7 per cent showed no metastases at the time of death which fact suggested that resectability and cure rates should be higher. In our own group of patients, the results have not been extremely encouraging but a certain degree of optimism would appear justifiable based on results and certain facts apparent from a study of invasion and metastases.

Mustard and Ibberson recently stated, after discussing surgical and radiation treatment, "With the technical details of treatment thus coming under reasonable control the time seems appropriate to examine closely the results of past treatment and thus to establish a base line for the assessment of future efforts."

During the 25 year period from 1931 through 1955, 253 cases of carcinoma of the esophagus were seen at Duke Hospital, and an analysis of these cases forms the basis of this report. All tumors were squamous cell carcinoma with the exception of 1 adenocarcinoma in the middle third of the esophagus. This patient died 13 days after gastrostomy, and the diagnosis was confirmed by autopsy. Adenocarcinomas in the lower third of the esophagus were excluded because of the difficulty in determining the point of origin, whether stomach or esophagus, and the known differences between squamous cell carcinoma of the esophagus and adenocarcinoma of the stomach.

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INCIDENCE

The distribution by color and sex was tabulated in Table I and by age in Table II. About one-half of the tumors were in the middle third, and one-fourth in each the upper and lower thirds of the esophagus.

PAST HISTORY

Three patients had a history of swallowing lye requiring treatment by dilatations in the years prior to the development of carcinoma. All 3 lesions were in the middle third. Two other patients had a history of dysphagia many years before the malignant tumor. The cause of the difficulty in swallowing was unknown, but both patients required dilatations which were followed by a long period of freedom from symptoms. Nine patients had a history of pellagra, a number having been in this hospital for treatment, and 1 patient had been in a prisoner-of-war camp on a limited diet for a period of 30 months about 2 years before the onset of symptoms of esophageal carcinoma. One patient had had carcinoma of the lip previously, 1 patient carcinoma of the cervix, and 3 patients carcinoma of the tongue. Of the latter, 1 patient had had pernicious anemia for 27 years.

SYMPTOMS

The average duration of symptoms was 5 months for upper third lesions, 5.2 months

TABLE I.—INCIDENCE OF CARCINOMA OF ESOPHAGUS BY SITE, SEX, AND RACE

	Male		Female		Total	
	White	Colored	White	Colored	No.	Per cent
Upper	28	7	21	5	61	24
Middle	48	41	19	14	122	48
Lower	33	14	15	8	70	28
Total	109	62	55	27	253	100
Per cent	43	25	22	10		

TABLE II.—AGE INCIDENCE IN CARCINOMA OF ESOPHAGUS

	Male		Female			
Age, yrs.	White	Colored	White	Colored	No.	Per cent
20–29	1	1	0	1	3	1.2
30–39	4	1	6	1	12	4.7
40–49	13	13	9	7	42	16.6
50–59	36	16	25	12	89	35.2
60–69	40	15	11	5	71	28.1
70–79	14	14	4	0	32	12.6
80–89	1	2	0	1	4	1.6
Total	109	62	55	27	253	

for middle third, and 5.9 months for lower third (Table III). Symptoms for 1 month or less prevailed in 23 per cent of patients with upper, 13 per cent with middle, and 10 per cent with lower third lesions. Dysphagia was the predominant symptom, being noted as the first symptom by 89.3 per cent of the patients and having occurred in 96.4 per cent. Odynophagia was present less frequently, and acute obstruction was the first symptom in only 2 cases. Symptoms suggesting invasion of contiguous structures, such as hoarseness, cough, and pain in the back were noted as tabulated in Table IV. Hemoptysis was infrequent and hematemesis was rare. Weight loss was markedin most of the patients, averaging 22.5 pounds in those with lesions of the upper third of the esophagus, 26.2 pounds in those with middle third lesions, and 30.2 pounds in those with lower third lesions.

EXAMINATION

Physical examination was notable in the absence of positive findings. The marked weight loss associated with this disease is well known, and the evidence of malnutrition and dehydration was obvious in many of these patients. Vocal cord paralysis was found in 7 patients with upper third lesions and once each in those with middle and lower third lesions. Palpable lymph nodes were noted in the supraclavicular region or cervical chain in 17 tumors of the upper third, 23 of the middle third, and 7 of the lower third. Two patients with tumors of the lower third of the esophagus had a palpable epigastric mass.

The other examinations of interest are noted in Table V. Fluoroscopic and roentgenographic study of the esophagus during swallowing of barium was carried out in nearly all patients. This procedure was remarkably accurate but it should be noted that in 5 cases (1.9 per cent), lesions were found by esophagoscopy which could not be identified by the roentgen examination. An absolute diagnosis was not made in every instance by either roentgenography or esophagoscopy, as 12.3 per cent of the biopsy studies of the esophagus were negative and in some a specimen could not be obtained.

Bronchoscopy was not carried out very often in the earlier years, but was more frequently done in the latter part of the series. Esophageal fistulas were noted initially in 2 patients, one into the trachea and one into the left main bronchus. Lymph node biopsy was also carried out more frequently in the more recent cases.

DISPOSITION OF PATIENTS

Sixty-five patients had essentially no treatment; some were inoperable and some

TABLE III.—DURATION OF SYMPTOMS OF CARCINOMA OF ESOPHAGUS

Duration	Upper, per cent	Middle, per cent	Lower, per cent
1 month or less	23	13	10
2 months or less	40	28	25
3 months or less	51	45	41
Over 3 months	49	55	59
Average	5 months	5.2 months	5.9 months

TABLE IV.—SYMPTOMS

	Upper (61 patients)	Middle (122 patients)	Lower (70 patients)
Dysphagia	59 (53)	117 (108)	68 (65)
Pain	14 (5)	45 (12)	17 (4)
Cough	5 (1)	10 (2)	3
Hemoptysis	8	7	4
Hoarseness	10 (1)	2	1
Acute obstruction	1 (1)	0	1 (1)
Pain in back	3	7	2

Frequency as first symptom in parenthesis.

refused treatment. Thirty-two patients had only gastrostomy, 13 irradiation therapy only, and 29 both gastrostomy and irradiation treatment. The first definitive resection for carcinoma of the esophagus at this hospital was performed in June 1942, about midway in the series from the standpoint of time, but only about one-fifth of the patients had been seen prior to 1942. In 15 patients exploration only was performed, and in 30 exploration and gastrostomy. Most of these were exploratory thoractomies, but in some of the lower third lesions the abdominal incision of the proposed abdominothoracic approach was sufficient to show that the lesion was not curable. Palliative resection was performed in 29 patients, and in 40 patients definitive resections were carried out in the hope of cure.

TABLE V.—PREOPERATIVE STUDIES

	Upper			*Middle*			*Lower*		
	Pos.	*Neg.*	*Not done*	*Pos.*	*Neg.*	*Not done*	*Pos.*	*Neg.*	*Not done*
Barium swallow	54	3*	4	128	0	4	68	2*	0
Esophagoscopy	50	0	11	101	0	21	59	1	10
Bronchoscopy	2	1	62	8	17	102	0	1	70
Biopsy esophagus	42	3	16	74	15	33	48	5	17
Lymph node biopsy	3	1	61	6	3	118	3	1	67

*Esophagoscopy positive.

TABLE VI.—CAUSES FOR NONRESECTABILITY IN 74 OPERATIONS

	Upper	*Middle*	*Lower*
Trachea	2 (1)	12 (5)	—
Bronchus	—	6 (3)	—
Aorta	—	15 (3)	4
Contiguous tissue	1 (1)	7 (3)	7 (2)
Regional nodes	2 (1)	12 (2)	12
Celiac Nodes	—	8 (4)	20 (7)
Liver	—	1	4
Other	2	1	1
No information	1	1	—

Of 74 operations, 45 were exploratory procedures and 29 palliative resections. The number in parenthesis indicates cases in which a single cause for nonresectability was identified.

PREOPERATIVE CARE

This phase of the treatment of these patients remains one of the most difficult and important factors in the ultimate result. The limitation of diet was probably longer than indicated by any patient but even so the average duration of symptoms for the entire group was nearly 6 months. During this period, marked nutritional deficiency occurred, and when complete or nearly complete obstruction developed these alterations became serious. The restoration of proper nutritional, fluid, and electrolyte balance in these patients was difficult if not impossible to attain. The presently available methods for determination of blood volume and the electrolytes are of considerable aid, accompanied by accurate recording of intake and output. Blood transfusions are necessary in most of these patients. Of the various means for increasing caloric intake, and particularly protein, none has been very satisfactory. Gastrostomy or jejunostomy has not been very successful for this purpose. A small plastic tube may at times be passed into the stomach and the intake increased by use of a high protein liquid for the tube feeding, but the diarrhea which may be associated is detrimental. An anabolic agent such as testosterone or one of the related compounds may prove of value. Even though every available measure is utilized to correct the malnutrition and its associated alterations, to treat impairment in cardiac, pulmonary, or renal lesions, and generally to improve the physical status of the patient, many came to operation in less than ideal condition.

OPERATIONS

Seventy-four operations were carried out in which a definitive resection could not be performed. Forty-five of these were exploration with or without gastrostomy, and 29 were palliative resections. The reasons for nonresectability are noted in Table VI, and these will be discussed later. Palliative resections were performed whenever feasible without undue risk because of the exceedingly beneficial effects to the patient of restoration of gastrointestinal continuity.

Of the 40 definitive resections, 4 were for upper third lesions and consisted of 2 Wookey procedures and 2 resections with cervical esophagogastric anastomosis. Fifteen

TABLE VII.—RESECTABILITY 1942 THROUGH 1955

	Upper		*Middle*		*Lower*		*Total*	
	No.	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*	*No.*	*Per cent*
Patients seen	36		104		55		195	
Operable	10	28	56	54	48	87	114	58
Palliative resection	2		15		12		29	
Definitive resection	4	11	15	14	21	38	40	21

TABLE VIII.—OPERATIVE MORTALITY

	Operations	*Deaths*	*Mortality, per cent*
Exploratory	45	6	13
Palliative resection	29	5	17
Definitive resection	40	10	25
Upper third	4	1	25
Middle third	15	6	40
Lower third	21	3	14

definitive resections were done for middle third lesions; all were resections with supra-aortic esophagogastric anastomosis. Twenty-one definitive resections were done for lower third lesions, all with esophagogastric anastomosis, usually infra-aortic.

RESECTABILITY

The operability and resectability rates were determined only for the patients seen from 1942 through 1955, as the first resection was done in June of 1942, as noted before. Operability was 28 per cent for upper third lesions, 54 per cent for middle third, and 87 per cent for lower third carcinomas (Table VII). Definitive resections could be performed in 11 per cent of the patients with upper third tumors, 14 per cent with middle third, and 38 per cent with lower third lesions. These percentages of resectability were determined on the basis of all patients seen in the period from 1942 through 1955. By considering operable lesions only, resectability rates were 40 per cent for upper, 27 per cent for middle, and 44 per cent for lower third tumors.

MORTALITY

The operative mortality was summarized in Table VIII. Two of these patients had widespread metastases and obviously would not have been operated upon had this been determined preoperatively. In 1 patient, the trachea was torn while attempting to free an adherent carcinoma and the trachea could not be closed. Two patients died after the esophagus had been torn in the region of the tumor during dissection, and infection followed. In 5 patients infection and empyema or mediastinitis or both developed; in 3 the anastomosis was known to have leaked, and this was assumed in the other 2 patients. Two patients expired after aspirating stomach content, both early in the series before the importance of the vagotomy effect was appreciated and the necessity for keeping the stomach empty by nasogastric tube suction was realized. Atelectasis was the major cause in the death of 2 patients, and cardiac and respiratory failure caused 4 deaths. One patient died of anuria following a transfusion reaction. One patient died during a grand mal seizure 3 days after operation, and no exact cause for death was found at autopsy. Postmortem examination was performed after all but 6 postoperative deaths.

The postoperative mortality rate for the 114 operations was 18.4 per cent. For definitive resections, the rate was 25 per cent. Six of these 10 deaths occurred after resections for middle third lesions; the mortality rate for resections of carcinoma in the middle third of the esophagus was 40 per cent. This was considerably higher than the 25 per cent and 14 per cent for lesions of the upper and lower thirds.

METASTASES AND INVASION

From the 40 definitive procedures, negative lymph nodes were noted in 20 specimens, positive nodes in 13, no nodes in 6, and no information was available in 1.

Some information concerning the behavior of squamous cell carcinoma of the esophagus was obtained by noting, in addition to the lymph node findings at the time of definitive resection, the reasons why definitive resection could not be done in 74 patients and by noting the results of postmortem examination in 25 cases. In 74 operations in which definitive resections could not be carried out, the most frequent cause of failure to resect definitively was invasion of contiguous

organs or tissues in middle third tumors and lymph node metastases in lower third cancers. The figures given in Table VI could not be absolutely accurate, as it is obvious that when an incurable lesion was recognized the operation was seldom extended in order to prove a second or third cause of incurability.

In the lesions of the middle third of the esophagus, invasion of contiguous organs or tissues was the cause or one of the causes of nonresectability 40 times, with apparent invasion of the wall of the aorta or the tracheobronchial tree predominating. Invasion of the prevertebral fascia or the soft tissues of the mediastinum was less frequent. Twenty patients had lymph node involvement, and in 6 of these nodal metastases were the only cause given which prevented resection with hope of cure. In the lower third carcinomas, the lymph node metastases, particularly to the nodes about the celiac axis, were the major cause of failure. Such metastases were noted 32 times and were the only cause in 7 patients.

In the 25 autopsy studies, no resection or exploration had been performed in 9 cases. Five of these were without lymph node metastases, the tumor having invaded the trachea or bronchus in 4 and the prevertebral fascia in 1 instance. Three cases with local node involvement also invaded the trachea or bronchus, and 1 involved both local nodes and contiguous soft tissue. Two tracheo-esophageal fistulas were noted in these 9 cases. Six autopsies were performed on patients who had had only an exploratory operation. Two patients had both local and distant lymph node metastases; of the 4 cases without node involvement, 3 invaded the trachea or bronchus and 1 the contiguous tissue. Three autopsies were done after palliative resection; 2 patients had local and distant node involvement, and 1 with negative nodes had tracheal invasion. Six autopsies were performed after definitive resection. In 1 patient, tumor was left in the proximal stump, but in 5 no residual carcinoma could be found.

TABLE IX.—RESULTS

	No.	Operative deaths	Lost	Living	Average survival of dead (mos.) Including oper.deaths	Excluding oper.deaths
No treatment	65	—	5	0	—	2.9
Gastrostomy only	32	4	2	1	3.4	3.9
Radiation only	13	—	1	0	—	6.5
Radiation and gastrostomy	29	0	0	0	6.9	6.9
Exploration only	15	1	5	0	4.0	4.4
Exploration and gastrostomy	30	5	1	0	3.7	4.5
Palliative resection	29	5	1	0	8.9	10.9
Definitive resection	40	10	0	10	8.5	12.6

Average survival time of 10 living patients in resected group was 59.7 months.

RESULTS

The results in this series of patients are shown in Table IX. The average survival period without treatment other than symptomatic was about 3 months; gastrostomy increased survival time to 4 to 5 months, and irradiation to about 7 months. After palliative resection the average period of survival was 11 months, but the relief of symptoms was decidedly beneficial. Those patients who died after definitive resection had an average survival period of 12.6 months, which figure would be considerably increased by including the living. Most of these patients died within the first year after operation, but 2 lived for more than 2 years.

Ten patients were living after definitive resection. Three had middle third tumors, 2 living at 25 and 26 months postoperatively had known recurrence, and 1 living at 90 months had no recurrence. Seven patients were living after resection of squamous cell carcinomas of the lower third of the esophagus. These patients were alive 28, 31, 36, 84, 84, 92, and 101 months after operation. Based on the 121 patients with carcinoma of the esophagus admitted during the 9 year period from 1942 through 1950, 5 patients survived for 5 years or more which gave a 5 year survival rate of 4.1 per cent. Twenty-two definitive resections were performed during this period so that the 5 year survival

FIG. 1. Posterolateral incision on left side, approximately midway between ribs to be resected.

of this group was 22.7 per cent including the postoperative deaths. In the group with carcinoma of the lower third of the esophagus, 11 patients had definitive resections and were discharged from the hospital. Of these, 4 (36.3 per cent) lived more than 5 years.

DISCUSSION

The incidence of carcinoma of the esophagus in this series is not unusual, although exclusion of adenocarcinoma of the lower third makes comparison difficult. Males predominated 2 to 1; the usual ratio varies between 8 to 1 and 4 to 1 although in Hanna's series it was only 1.3 to 1. The peak incidence was a decade lower in women than in men. Six per cent of the patients were under 40 years of age, in constrast to 3 other series showing 0 per cent, 0.5 per cent, and 0.6 per cent. The duration of symptoms, symptomatology, and physical findings were not unusual in our series. A past history of pellagra is not infrequent in this area but may be of interest. The dependability of esophagoscopy in the diagnosis of carcinoma of the esophagus deserves repeated emphasis.

The preoperative care of these patients presents a challenging problem. In most of the patients, weight loss has been severe, and the nutritional deficiency is reflected in negative protein balance, decreased blood volume, anemia, and essentially any other measure used. Efforts to restore these deficiencies are not very successful. Careful administration of proper fluids and electrolytes, blood or plasma transfusions, protein hydrolysates orally or intravenously, and vitamins orally or parenterally are of decided value but seldom will restoration to positive nitrogen balance occur. Small plastic tubes may occasionally be passed into the stomach and the intake increased. Gastrostomy and jejunostomy have not been beneficial. If the operative morbidity and mortality could be held to an acceptably low level, retrosternal transplantation of jejunum or colon might be advisable as the first stage to correct nutritional status. Should a non resectable tumor be found at next operation, palliative restoration of gastro-intestinal continuity would already have been established.

The operative approach in the cervical region is fairly well standardized. For lesions of the lower third of the esophagus, a low posterolateral thoracic or a combined abdominothoracic incision may be used. Certain advantages are offered by each. The combined incision permits excellent exposure of all the structures involved so that the tumor is more readily mobilized under direct vision, the blood supply of the stomach is under good control, and extended maneuvers such as freeing the duodenal loop may be performed without difficulty. If the abdominal portion of the incision is made first, metastases within the abdomen will be recognized and thoracotomy avoided unless palliative resection is indicated. The combined abdominothoracic incision takes a little longer to make and to close but healing is generally very satisfactory. The low thoracic approach can be made and closed more rapidly, exposure of the tumor is usually satisfactory, and the stomach can be mobilized through an incision in the diaphragm.

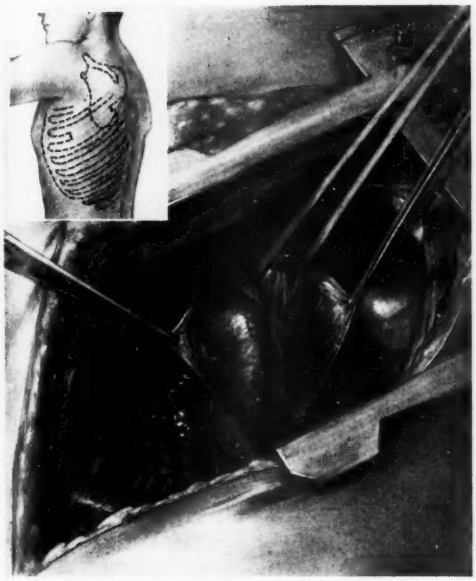

FIG. 2. Removal of fourth rib gives excellent exposure for esophageal lesion near arch of aorta.

FIG. 3. Removal of ninth rib permits mobilization of lower part of esophagus and stomach.

A variety of approaches have been described for the middle third lesions. The usual incision has been posterolateral, entering the chest through the fifth or sixth rib bed. Mobilization of the stomach has usually required a separate abdominal incision. Because of the difficulty in freeing the tumors at the arch of the aorta, an approach from the right side has been used frequently, the rib resected depending on the exact site of the lesion. Better visualization of the tumor is obtained, and the anastomosis may be more easily performed. This approach also usually necessitates an abdominal incision.

For several years we have found the incision illustrated in Figures 1, 2, and 3 useful in selected patients with middle third lesions. The posterolateral incision is placed so that both the fourth and ninth ribs may be resected, thus allowing exposure of a carcinoma at the aortic arch, then mobilization of the stomach through the diaphragm via the ninth rib bed, and finally the anastomosis under direct vision through the upper wound. An abdominal incision may thus be avoided, operative trauma decreased, and operating time shortened. The usual principles regarding anastomosis are observed: clamps are not used, the blood supply is preserved, tension is avoided, and accurate approximation is obtained. Interrupted fine silk or catgut is used for the mucosa and fine silk for the submucosa and muscularis. Adherence to the basic principles is more important than the exact suture used (4), other than a continuous encircling should be avoided, and a properly performed anastomosis should seal as rapidly as an intestinal anastomosis with two serosal layers (5).

Tracheotomy is performed on all patients who have had resection of a middle third carcinoma, as the postoperative course is greatly enhanced by thorough removal of the secretions in the trachea and bronchi. A small nasogastric tube with continuous suction keeps the stomach deflated and will not interfere with healing of the anastomosis. Intercostal catheter chest drainage with underwater seal or suction is routinely employed. Oxygen, blood, intravenous fluids,

and electrolytes and antibiotics are given as indicated.

The postoperative mortality has been highest in those with middle third lesions. Some improvement has occurred in the last 5 years, but if 5 year survival is to be increased, then further decrease in the hospital mortality must be attained. As suggested previously, improved methods for restoring nutritional depletion would be of value, and better technical methods would be desirable.

Whereas we believe that a re-evaluation of irradiation therapy for carcinoma of the esophagus must be made with the new supervoltage technique now available, surgery still has much to offer, and better methods can be anticipated. The fact that one-half of our patients who had definitive resection had negative lymph nodes is encouraging, although more distant node metastases may have been present. In 18 autopsy examinations in patients who had no resection, 10 had no lymph node metastases. Although one is hesitant to find encouragement in operative deaths after definitive resection, 5 of 6 such cases at autopsy showed no residual carcinoma. In the remaining case, tumor was left in the proximal segment which could have been removed. Obviously, extensive resection with a wide margin of normal tissue cannot be carried out with the restrictions imposed anatomically in the mediastinum but more thorough, meticulous dissection might be possible. Invasion of the trachea, left main bronchus, aortic wall, or prevertebral fascia may be resectable later.

Palliative resection occupies an extremely important place in the treatment of squamous cell carcinomas of the esophagus and should be utilized whenever feasible without unduly jeopardizing the patient's life. With restoration of the ability to swallow, nutrition can be maintained, and the physical and psychologic comfort afforded are an immeasurable improvement for these cases. Many patients can eat and remain relatively well nourished until death. Ability to swallow saliva, prevention of bronchoesophageal fistula and aspiration pneumonitis, and avoidance of gastrostomy are other possible benefits of palliative resection.

In squamous cell carcinoma of the esophagus, the 5 year survival of patients without apparent recurrence was 4.1 per cent when determined on the basis of all patients seen from 1942 through 1950. This represented a survival of 22.7 per cent of those who had definitive resection. A survey of recently reported series provides adequate reason in the low survival rates for the pessimistic attitude which has developed. A survival of 4.1 per cent of all patients or of 22.7 per cent of all who had definitive resections in this series provides little ground for optimism, but it is sufficiently encouraging that efforts to improve the preoperative care and the operative technique should continue.

SUMMARY

The incidence, symptomatology, and diagnostic findings of 253 patients with carcinoma of the esophagus have been analyzed. In the group admitted since January 1942, operability was 58 per cent and resectability 21 per cent, both being considerably higher in tumors of the lower third of the esophagus. All patients had squamous cell carcinoma except 1 with adenocarcinoma of the middle third of the esophagus. Invasion of the mediastinal structures was the most frequent cause for nonresectability in middle third lesions and lymph node metastases in the lower third lesions. The postoperative mortality rate after definitive resection was 25 per cent. Five patients with squamous cell carcinoma of the esophagus survived over 5 years and were living without evidence of recurrence up to 8 years and 5 months.

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INTRAVENOUS CHOLANGIOGRAPHY: CORRELATION WITH OPERATIVE FINDINGS IN 72 PATIENTS

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CHOLANGIOGRAPHY following the intravenous injection of cholografin[1] has been established as one of the useful adjuncts in the diagnosis of biliary tract disease. In the majority of patients a thorough history and physical examination supplemented by an oral cholecystogram will reveal ample evidence for the correct diagnosis. However, for those in whom the exact nature and extent of the disease process remains uncertain the intravenous cholangiogram has proved its use. In addition it leads to a better understanding of that group of patients who continue to have or develop new symptoms following cholecystectomy. For the patients who have complaints presumably due to disease of other organs it is of value in excluding disorders of the biliary tract.

A previous report on intravenous cholangiography from The New York Hospital-Cornell Medical Center was presented in 1954 (1). In the 3 year interval since then approximately 1,200 cholangiograms have been performed on 1,000 patients. With this additional experience it is felt timely to review the indications and accuracy of the intravenous cholangiogram.

INDICATIONS

As experience accumulates the use and limitation of new tests and procedures become more evident. The following indications for intravenous cholangiography are those which are now most widely used and have been demonstrated to be of the greatest value to the surgeon: (1) failure of visualization of the biliary tract by oral cholecystogram; (2) common duct stones suspected by history, physical examination, or laboratory determinations; (3) suspicion of acute cholecystitis; (4) recurrent or persistent symptoms following cholecystectomy.

There are many other instances in which the intravenous cholangiogram is of value. To determine the presence or absence of a normal extrahepatic biliary system, to evaluate the common duct in the presence of pancreatic disease, to achieve a rapid evaluation of the biliary tract, and to avoid oral medication as is often desirable in children are additional indications.

The contraindications are few. Hardie recently reviewed the reports from other clinics and found only occasional mild side reactions. These usually consisted of flushing of the face, slight nausea, or a mild erythematous rash. The experience at this center has been similar. Caution is still exercised in those patients with hyperthyroidism who have received iodine preparations and in those who may have an idiosyncrasy to iodine.

There is minimal danger in doing the cholangiogram in patients with liver disease. A battery of liver function tests was obtained on 10 cirrhotic patients 2 days before and again 5 days after intravenous cholangiography (4). These patients initially had marked impairment of liver function as evidenced by bromsulphalein retention of over 12 per cent in 7 of the 10 patients and 3 to 4+ cephalin flocculation in 9 of the 10 patients studied. There was no significant change in the liver function studies following cholangiography.

We have found the level of serum bilirubin to be one of the best guides in choosing the optimum time to attempt cholangiogra-

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[1] Cholografin is a 20 per cent isotonic solution of the disodium salt of N,N adipyl-bis (3-amino-2, 4, 6-triiodo)—benzoic acid whose empiric formula is $C_{20}H_{12}O_6N_2I_6Na_2$.

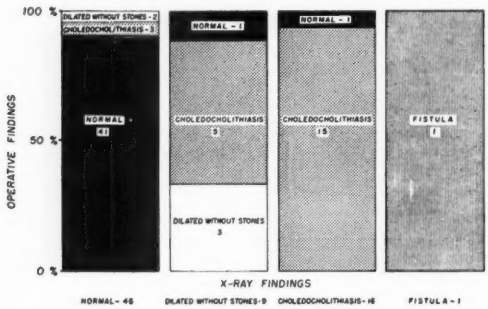

CHART 1. Intravenous cholangiography correlated with operative findings in 72 cases.

phy. Recently, it has been our policy to obtain a serum bilirubin determination at the time of admission and the morning the intravenous cholangiogram is to be performed. If the bilirubin is greater than 3 milligrams per cent the test is withheld until the bilirubin has fallen. By performing the bilirubin determination and cholangiogram on the same day the interpretation of nonfunction is more accurate.

A review of 35 patients who had a serum bilirubin determination and intravenous cholangiogram the same day revealed that 21 of 27 patients with a serum bilirubin less than 3 had opacification of the biliary tree (Table I). Of the 6 with a bilirubin less than 3 in which there was inadequate opacification, 1 had biliary cirrhosis, 2 had acute cholecystitis, 1 had a common duct stone,

TABLE I.—CORRELATION OF SERUM BILIRUBIN WITH VISUALIZATION OF THE COMMON DUCT

Serum bilirubin, milligrams per cent	*Visualization*	*Inadequate visualization*	*Total*
0.0–0.9	10	2	12
1.0–1.9	9	3	12
2.0–2.9	2	1	3
3.0–3.9	0	1	1
4.0–4.9	0	0	
5.0–5.9	0	2	2
6.0+	0	5	5
Total	21	14	35

and in the remaining 2 no reason for nonvisualization was apparent.

The bromsulphalein retention is not as useful as the serum bilirubin in the selection of patients for cholangiography. Visualization of the biliary tree was accomplished in 5 of the 6 patients with cirrhosis who had over 12 per cent retention of bromsulphalein. Of these, 3 had over 20 per cent retention of the dye in 45 minutes. Likewise, no correlation could be made between the degree of visualization and the level of cephalin flocculation, serum protein, alkaline phosphatase, or thymol turbidity.

RESULTS

The records of the pavilion and the senior author's patients who had an intravenous cholangiogram have been reviewed. The 72 patients who had visualization of the extrahepatic biliary tract and who subsequently had examination of the area at operation form the basis of this report.

TABLE II.—OPERATIVE FINDINGS AND PATHOLOGIC DIAGNOSIS

	Comon duct at operation				
	Normal	*Dilated*	*Choledocholithiasis*	*Fistula*	*Total*
Chronic cholecystitis					
With cholelithiasis	24	1	9(b)(c)	—	34
Without cholelithiasis	4(a)(b)	—	2	—	6
Acute cholecystitis					
With cholelithiasis	8(b)	1	1	—	10
Without cholelithiasis	1	—	—	—	1
Postcholecystectomy					
Gallbladder and cystic duct removed	0	1(e)	8(d)	1	10
Gallbladder remnant or cystic duct remnant	5	1(f)	3	—	9
Cholesterolosis	2(a)	—	—	—	2
Pancreatitis	2(a)	2(e)(f)	1(d)	—	5
Carcinoma of the gallbladder	—	—	1(c)	—	1

(a) One patient had chronic cholecystitis with cholesterolosis and pancreatitis.
(b) One patient had a previous cholecystostomy.
(c) One patient with carcinoma of the gallbladder had chronic cholecystitis with cholelithiasis.
(d) One patient who had gallbladder and cystic duct removed had pancreatitis.
(e) One patient who had gallbladder and cystic duct removed had pancreatitis and fibrosis of sphincter of Oddi
(f) One patient who had a cystic duct remnant had pancreatitis.

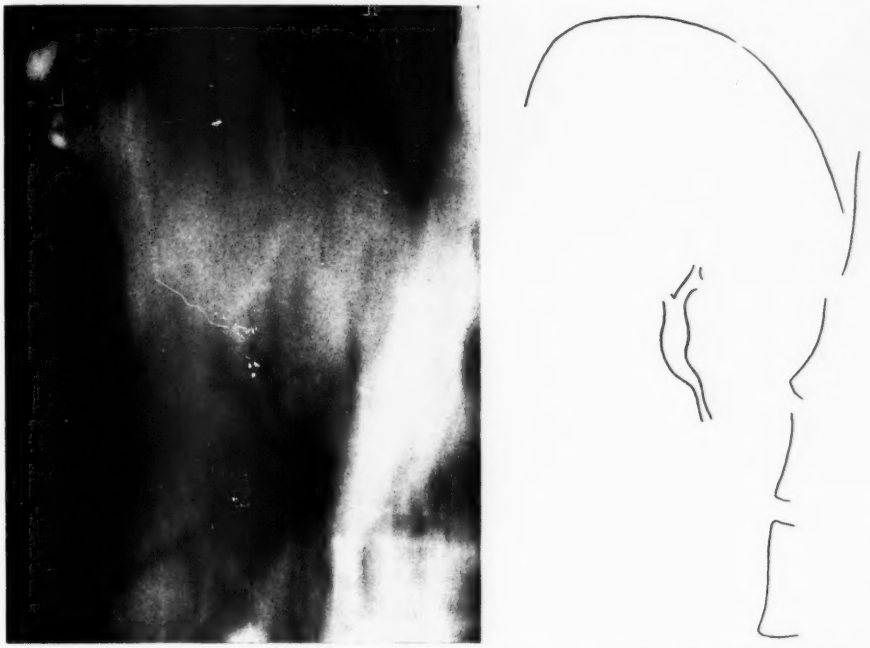

FIG. 1. Case 1. Intravenous cholangiogram showed opacification of an unremarkable common duct. The gallbladder did not visualize. At operation the patient had subacute cholecystitis in an acalculous gallbladder.

The series includes 50 female and 22 male patients, a ratio of 2.3 to 1. The average age in the series was 52.8 years. Forty-six patients were diagnosed as having a normal common duct by intravenous cholangiography. Dilatation was present in 9; 16 were said to show choledocholithiasis; and 1 was stated to have a fistula. A comparison of these diagnoses with the operative finding is presented (Chart 1).

Should the radiologist interpret the common duct as dilated without other evidence of stones and the surgeon finds stones, credit is due the radiologist for drawing the surgeon's attention to the abnormality. Excluding this group, the intravenous cholangiogram failed to yield the correct diagnosis in 7 of the 72 patients. Five of the 7 were in the group in which the cholangiogram was read as normal.

Exploration of the common duct was performed on 42 patients. Of the 46 patients whose intravenous cholangiogram was reported as normal, 17 had a choledochotomy. Of the 26 patients in whom intravenous cholangiogram demonstrated some abnormality, all but 1 had an exploration of the common duct. In the remaining patient the cholangiogram was read as showing a dilated common bile duct whereas at operation the duct was considered normal.

The series has been further broken down into pathologic diagnosis in Table II. There were 40 patients with chronic cholecystitis who had visualization of the common duct by cholangiogram. Thirty-five of the radiologic diagnoses were substantiated at operation. It was in this group that 3 of the common ducts reported as normal by the radiologist contained stones and 1 described as containing stones was normal. One of the common ducts interpreted by x-ray examination as normal proved to be actually slightly dilated.

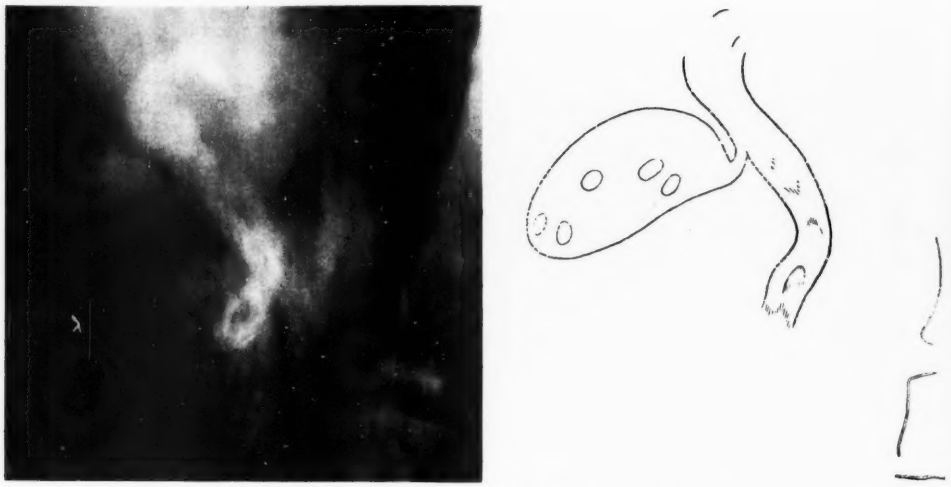

FIG. 2. Case 2. The intravenous cholangiogram demonstrated cholelithiasis and choledocholithiasis which finding was substantiated at operation.

Ten of the 11 cases of acute cholecystitis were correctly diagnosed. The 1 in error was of a normal common duct that was described after roentgen examination as dilated.

In 15 of the 19 patients who had had previous cholecystectomy, a correct diagnosis was made by intravenous cholangiography. Three patients in whom the radiologist observed dilatation without other evidence of stones had choledocholithiasis at operation. In 1 described as normal dilatation was actually observed at operation.

In the 5 patients who had pancreatitis the intravenous cholangiogram led to a diagnosis substantiated by operation except in 1 in whom the common duct was described as normal and at operation was found to be dilated.

CASE SUMMARIES

CASE 1. A 72 year old female during the 2 month period prior to this admission had intermittent belching following meals. At times this was accompanied by pain in the right upper quadrant of the abdomen. Oral cholecystogram performed at another hospital was reported to have shown a diseased gallbladder. She refused surgery. Another oral gallbladder series was attempted the day of admission but again no opacification of the gallbladder was seen. Following the examination the patient had severe right upper quadrant pain and began to vomit. Physical examination revealed moderate epigastric tenderness but no masses. Temperature, pulse, respirations and hemogram were normal. Bilirubin was 1.2 milligrams per cent with 0.9 milligram per cent in the direct fraction. Alkaline phosphatase was 8.1 units. Because of the suspicion of acute cholecystitis an intravenous cholangiogram was performed and revealed nonvisualization of the gallbladder, and a normal common duct (Fig. 1). At operation the gallbladder wall was not grossly thickened and no calculi were palpable. The common duct was small and on careful examination there was no evidence of stones. Because of the patient's symptoms and repeated nonfunctioning Graham's tests the gallbladder was removed. Pathologic examination revealed subacute cholecystitis.

Following the operation the patient developed a biliary fistula. On the twenty-first postoperative day an intra-abdominal abscess was drained and the fistula subsequently healed. In the year since cholecystectomy she has been readmitted twice for episodes of epigastric pain associated with chills and fever. Intravenous cholangiograms have shown a normal common duct.

With nonvisualization of the gallbladder by both oral and intravenous cholecystography there is little doubt that the gallbladder is diseased. The slightly elevated bilirubin frequently associated with acute cholecystitis is misleading as it is often unassociated with common duct stones (2). An

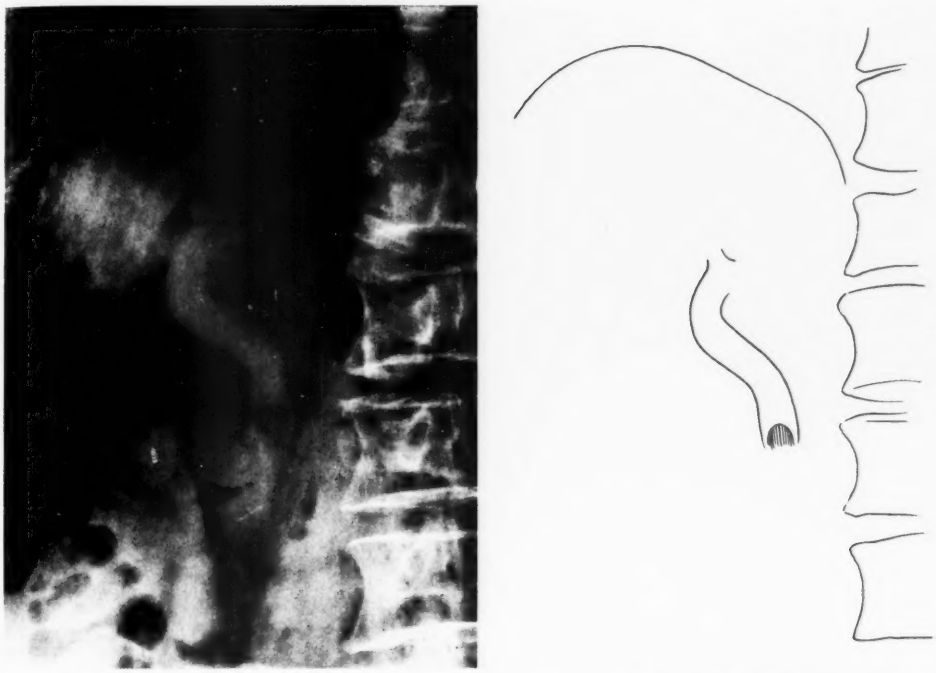

FIG. 3. Case 3. The intravenous cholangiogram showed a stone in a markedly dilated common duct. The gallbladder did not visualize. Operation revealed a carcinoma of the gallbladder and a common duct stone.

intravenous cholangiogram is of great value in visualizing the common duct in these cases.

CASE 2. A 61 year old hemiplegic female[2] had fatty food intolerance with postprandial bloating and belching for many years. Six years prior to this admission she had an attack of right upper quadrant colicky pain radiating to the right scapula and associated with nausea. For the 7 weeks previous to admission she had intermittent nausea and anorexia with occasional vomiting. Three days before the present hospitalization she developed moderate right upper quadrant pain radiating to the scapula. She had had a simple mastectomy 3 years previous for carcinoma of the breast. On admission her temperature was 37 degrees C., pulse rate 80 per minute and respiratory rate 20 per minute. Examination revealed no jaundice. There was no abdominal tenderness or masses. Bilirubin was 2.1 milligrams per cent and alkaline phosphatase was 26.2 units. An oral cholecystogram revealed nonopacification of the biliary tract. This was followed the same day by an intravenous cholangiogram which showed cholelithiasis and choledocholithiasis (Fig. 2). At operation the gallbladder wall was seen to be thickened and acutely inflamed. It contained numerous stones. The common duct was dilated and exploration revealed many stones of various sizes. A cholecystectomy and choledocholithotomy were performed. She had an unremarkable postoperative course and in the short interim since has been doing well.

CASE 3. A 76 year old female had an episode of right upper quadrant pain associated with intermittent nausea and anorexia 4 months prior to admission. Examination of the abdomen at this time was unremarkable. Two oral cholecystograms did not visualize the biliary tract. Intravenous cholangiography showed a stone in a markedly dilated common duct (Fig. 3). She refused admission. She remained asymptomatic save for anorexia. The day prior to admission a 6 centimeter tender mass was felt in the right upper quadrant. Hospitalization was accepted. Hemogram was within normal values. Bilirubin was 0.4 milligram per cent and alkaline phosphatase was 4.6 units. At operation the common duct was dilated and did contain a stone. Many stones were palpated in the gallbladder and its fundus was markedly indurated. A frozen section revealed carcinoma of the

[2] Patient of Dr. Russell H. Patterson.

FIG. 4. Case 4. Intravenous cholangiography demonstrated a cystic duct remnant and choledocholithiasis. Operation revealed a 2 centimeter cystic duct remnant and 2 common duct stones.

gallbladder with extension into the liver. A cholecystectomy and choledocholithotomy were performed. In the 7 months subsequent to her discharge she has continued to have anorexia and weight loss. A large mass was palpated in the right upper quadrant when last seen.

This case illustrates the value of the intravenous cholangiogram in patients presenting symptoms suggestive of biliary tract disease. A diagnosis of choledocholithiasis was made months before surgery was performed. Operative removal of the gallbladder before it became the site of origin for the tumor might have averted its development. This patient refused early therapy and at subsequent operation a curative procedure could not be carried out.

CASE 4. A 53 year old female had a cholecystectomy at another hospital 10 years prior to this admission. Seven years later she began to have epigastric pain relieved by food. A gastric ulcer was demonstrated on gastrointestinal roentgenogram. A partial gastrectomy was performed 18 months before this admission. At this time an alkaline phosphatase of 22.8 units without other abnormalities in liver chemistries was noted. She was asymptomatic until 1 year prior to admission. She had intermittent moderate nonradiating epigastric pain. Subsequent intravenous cholangiograms revealed a cystic duct remnant and common duct stones (Fig. 4). Physical examination revealed no jaundice or tenderness. Bilirubin was 0.6 milligram per cent and alkaline phosphatase was 25.9 units. At operation a 2 centimeter cystic duct remnant was removed and two 1½ centimeter common duct stones were extracted from the common duct. At present, 18 months following operation, she is asymptomatic.

For patients who develop symptoms following cholecystectomy the intravenous cholangiogram should be of great value. Some of these patients have a long cystic duct remnant. After careful evaluation of adjacent organs the remnant should be removed. If, as in this case, the cystic duct

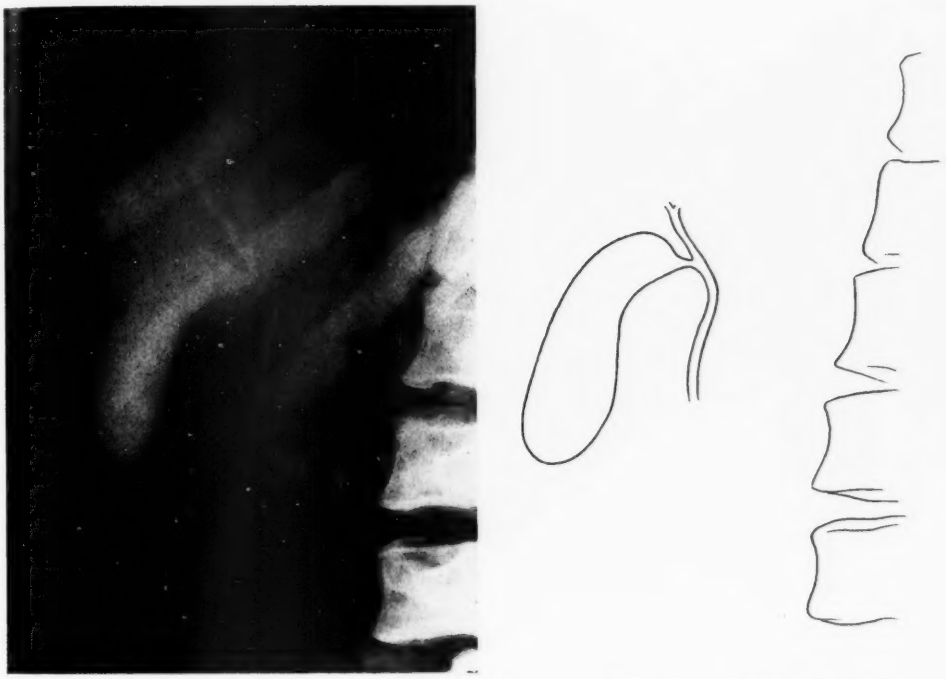

FIG. 5. Case 5. The intravenous cholangiogram demonstrated a functioning gallbladder and an unremarkable common duct in the presence of recurrent pancreatitis.

remnant is in association with common duct stones, it should certainly be excised as it could easily be the site of formation of stones that pass into the common duct.

CASE 5. A 31 year old male was first admitted to The New York Hospital-Cornell Medical Center in June 1953 with a 2 year history of marked epigastric pain. He had been taking alcohol heavily for a number of years. Five hours prior to admission after drinking some whiskey the pain became acutely severe with nausea and vomiting. Examination revealed epigastric tenderness but no masses. Serum amylase on admission was 517. Symptoms subsided on a conservative regime.

Similar episodes occurred in June, September, and October of 1954. Intravenous cholangiograms were normal during these admissions. The patient refused surgery until February 1955. He was again admitted with epigastric pain and vomiting following alcohol. His serum amylase was 408 units and bilirubin 0.8 milligram per cent. Intravenous cholangiogram revealed a normal opacification of the galbladder and common duct (Fig. 5). At operation the biliary tract was demonstrated to be normal without dilatation of, or stones within, the common duct.

In this instance the cholangiogram helped rule out biliary tract disease as the cause of recurrent pancreatitis.

CASE 6. A 66 year old male 9 years prior to admission had a cholecystectomy for cholelithiasis and chronic cholecystitis. The common duct and pancreas were unremarkable at this time. He was well until a few days before this admission when he developed a continuous pain in the midback and right upper quadrant. Physical examination was unremarkable as related to the present illness. Bilirubin was 0.8 milligram per cent, alkaline phosphatase was 2.6 units, and amylase was 54 units. Intravenous cholangiogram revealed a rounded radiolucency in a dilated common duct (Fig. 6). Operative findings confirmed a 4 by 6 by 2 millimeter stone in a dilated common duct. The head of the pancreas was indurated. Although there was no fat necrosis it was felt this represented chronic pancreatitis or possibly carcinoma. Following choledocholithotomy he had an uneventful course and he was asymptomatic when last seen 1 year following operation.

This is illustrative of a patient who developed postcholecystectomy symptoms.

FIG. 6. Case 6. The intravenous cholangiogram revealed a rounded radiolucency in the common duct. Operation substantiated these findings and also revealed an indurated head of the pancreas.

One would have been hesitant to subject this patient to operation with a negative physical and laboratory examination. The intravenous cholangiogram established the diagnosis and left no doubt that the common duct should be explored.

DISCUSSION

The experience of this clinic and the reports of other authors show that intravenous cholangiography yields good results when used properly. As radiologists review an increasing number of roentgenograms following intravenous cholografin the accuracy of diagnosis improves. If the indications outlined are used in patients whose serum bilirubin is less than 3 milligrams per cent maximum efficiency in performance of the cholangiogram and in arriving at the correct diagnosis should result. Failure to visualize the ductal system satisfactorily might seem to indicate that the method contributed little to preoperative evaluation. Quite the opposite we believe to be true, because when a patient receives the usual dosage of cholografin intravenously without satisfactory opacification of the ductal system, it clearly demonstrates that the dye has not been excreted by the liver normally. Several factors may play a role in this. First is impairment of the excretory function of the Kupffer's cells of the liver, second there is an extrahepatic block with increased back pressure that prevents the dye from entering the ductal system. Obesity of the patient may also prevent visualization of the ductal system on the roentgenogram in spite of the fact that the dye may be present.

Intravenous cholangiography has not replaced any laboratory procedure. It is an addition to the ones already available. Oral cholecystography remains the most reliable method of evaluating the function of the gallbladder. Utilizing the knowledge that intravenous cholografin is excreted by the liver and oral telepaque is concentrated in the gallbladder, some authors have recom-

mended that these tests be combined. Although this has not been done routinely at this clinic we frequently perform the intravenous cholangiogram the same morning the roentgenograms following oral telepaque are being taken. This method has been of value in selected cases.

There are many laboratory procedures that are of assistance in the diagnosis of biliary tract disease; their potentialities have not been developed completely. These we may anticipate will be more efficiently utilized in the future while at the same time the new ones will be developed. We think however that it should be re-emphasized that none of these aids are capable of replacing an accurate history and thorough physical examination.

SUMMARY

1. Seventy-two patients who had adequate roentgen opacification of the common duct following intravenous cholografin and subsequently were operated upon have been reviewed.

2. Indications for intravenous cholangiography include failure of biliary tract visualization by oral cholecystography, suspicion of common duct stones, acute cholecystitis, and persistence of symptoms following cholecystectomy.

3. It is unusual for the common duct to opacify with a bilirubin greater than 3 milligrams per cent.

4. Used in the proper instances the accuracy of intravenous cholangiography should be around 90 per cent.

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AN ANALYSIS OF ONE HUNDRED CASES OF RECURRENT CANCER OF THE UTERINE CERVIX

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PATIENTS WITH RECURRENT CANCER of the cervix have a brief life expectancy and treatment is ineffective.

The present study constitutes a review of the cases of 100 patients in whom the recurrence was first recognized in the 11 year period from 1939 to 1949. All patients seen in this period who were apparently free of disease for at least 3 months following the initial treatment are included. They are divided according to the previous treatment: a radical hysterectomy is called adequate surgery; a lesser procedure is called inadequate surgery. Full pelvis x-ray—3,000 roentgen depth dose and 4,000 milligram hours radium or more—is called adequate radiotherapy; less than that is called inadequate. Adequate radiation had been received by 68 patients and adequate surgery by 6, adequate radiation and surgery by 1, leaving 25 with inadequate initial treatment. The time of recurrence is indicated in Table I suggesting that it occurs sooner after inadequate treatment. There are only 6 post-surgical cases in the adequate therapy group but they exhibit a time of recurrence that is no different from the group of irradiated patients.

When first recognized, the recurrence was apparently confined to the cervix or vagina in 54. It was still limited to the pelvis in 28. In 15, the tumor had spread beyond the pelvis and in 3, the extent of disease was not recorded.

In the past, recurrence has been suspected or recognized clinically and confirmed by biopsy. In 1943, cytology began to be widely used and has shown its value in 13 cases as the first evidence of recurrence, preceding clinical signs or symptoms. In 36 patients, vaginal smears were not taken so that in the group of 64 in which cytology was available, 20 per cent were detected by this means before such time as the tumor was clinically evident.

The treatment of these recurrent lesions was individualized and varied from none at all in 17, through various palliative procedures to repeated radiotherapy or radical surgery to exenteration in 3. The radical hysterectomy and regional lymphadenectomy were of the standard variety developed and described by Meigs. The radiotherapy was mostly supervoltage x-ray delivering a mid pelvic dose of 3,000 to 4,000 roentgens. Occasional patients received radium (1,500 to 3,500 mgm. hrs.) alone or in conjunction with the roentgen therapy.

Only 5 patients were symptom-free at 5 years; 3 of these patients were treated with radiotherapy, and 1 each with radical hysterectomy and exenteration. This is a remarkably poor cure rate. The effectiveness of the type of treatment cannot be evaluated because of selection and because of the small numbers of patients included in the study.

TABLE I.—CASES DIVIDED ACCORDING TO PREVIOUS TREATMENT AND THE TIME OF DEVELOPING THE RECURRENCE

Time of recurrence in months after primary treatment	*—Inadequate treatment—*			*—Adequate treatment—*		
	Radiation	*Surgery*	*Radiation and surgery*	*Radiation*	*Surgery*	*Radiation and surgery*
0–5	2	1	2	5	1	0
6–11	4	2	4	20	2	1
12–23	3	1	4	19	1	
24–35			0	10	1	
36–47			1	0	0	
48 or more			1	14	1	
Totals	9	4	12	68	6	1

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TABLE II.—CYTOLOGIC DIAGNOSIS AT THE TIME RECURRENCE IS RECOGNIZED

Clinical site of recurrence	*Positive*	*Doubtful*	*Negative*	*Not done*
Vagina or cervix	20(10)*	4	5	25
Pelvis	2	4	16	6
Distant	1(1)*	1	8	5
Unknown	3(2)*			
Totals	26(13)*	9	29	36

( )* The cytologic diagnosis preceded the clinical diagnosis.

TABLE III.—SUMMARY

Treatment of the recurrence	*No.*	*Duration of survival in months*		*No. symptom-free at 5 years*
		Mean	*Range*	
Radiation	59	17.5	0–120	3
Radical hysterectomy	7	25.8	9–63	1
Exenteration	3	27.6	1–66	1
Local surgery	7	4.5	1–10	0
Cordotomy only	3	6.3	4–9	0
Retroperitoneal node dissection only	3	7.6	5–10	0
Testosterone	1	5	5	0
No treatment	17	7.5	0–48	0
All	100	7.5	0–120	5

One patient survived 48 months without treatment. She was 49 years old and had a stage III lesion of the cervix treated with adequate radiotherapy (3,000 r. full pelvis x-ray and 4,800 mgm. hrs. radium) in August 1942. A stricture of the bowel developed from the radiation necessitating a colostomy. In February 1944, a biopsy from a bleeding area at the vaginal apex showed carcinoma. No treatment was given and she was symptom-free until January 1948 when she was seen with a fecal impaction and atypical pneumonia. She died February 7, 1948, apparently of cardiovascular failure. Postmortem examination showed severe arteriosclerosis, a recent coronary infarction, and pulmonary metastases.

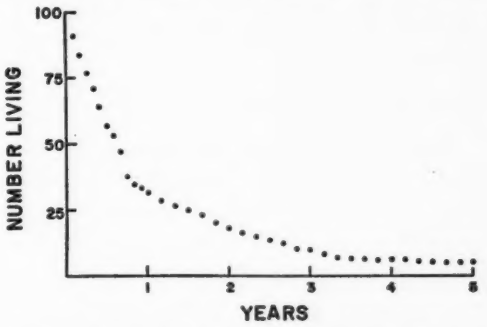

FIG. 1. Duration of survival after recognition of recurrence of cancer of the cervix in 100 cases.

If the number surviving is plotted against time, we find that only 50 per cent are living at 7.5 months, that 32 per cent are alive at 1 year, 18 per cent at 2 years, and 5 per cent at 5 years (Fig. 1). All but 3 patients are now dead. Those living were last seen at 65, 85, and 120 months following treatment of the recurrence.

Three patients died of causes apparently unrelated to malignancy, i.e., cardiac failure in 2 and cerebral vascular accident in 1. Two died of pyelonephritis apparently free of cancer, but the renal failure resulted from the treatment—surgery in one case and radiation in the other. One died of a gas bacillus infection arising from a rectovaginal fistula due to tumor. One patient died immediately following an exenteration. Five patients were listed as dying of cancer of other sites, i.e., intestine, colon, breast, ovary, and bladder. It is hard to evaluate these as they were clinical diagnoses on the death certificate

TABLE IV.—PATIENTS LIVING 5 YEARS OR MORE WITH NO EVIDENCE OF RECURRENCE

Initials and hospital No.	*Primary treatment*	*Interval between primary and secondary treatment*	*Stage equivalent at recurrence*	*Treatment of recurrence*	*Result*
AW 656305	Radium 3500 mgm.hr. X-ray 3000 r.	9 months	III	Radical hysterectomy and regional lymphadenectomy (positive nodes)	Died at 5 5 years of renal failure. No cancer at autopsy
EW 65413	X-ray 3000 r. Radium 3180 mgm.hr.	2.5 years	I	1140 mgm.hr. radon seeds	Died 9 years coronary heart disease
EB 683679	Supracervical hysterectomy	6 months	IV Bladder involved	Total exenteration (negative nodes)	O.K. 6 years
LK 652178	Total hysterectomy	6 months	IIb	X-ray 4150 r. full pelvis depth dose	O.K. 7 years
AC 280777	Total hysterectomy	6 months	III	X-ray 4900 r. full pelvis depth dose	O.K. 10 years

and not confirmed by autopsy. Cancer of the cervix is listed as the cause of death in 87 patients.

CONCLUSION

Recurrent cancer in the uterine cervix is a lethal disease. Only 5 per cent of patients survive 5 years. Radiation and surgery as used here were not very effective. Other methods of treatment, therefore, should be tried.

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EDITORIAL

THE OPPORTUNITY FOR THE EARLY TREATMENT OF LUNG CANCER

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THE PUBLICATIONS of the results of the treatment of bronchogenic carcinoma during the last decade are now rather numerous and to a large extent have portrayed this lesion as one which is not often cured. The experience in most medical centers has revealed that approximately half of the patients seen with lung cancer are obviously incurable and that of the remainder who are subjected to exploratory operation about one-third of them are found to be inoperable. In about two-thirds of the remaining patients gross or microscopic evidence of extension of the growth beyond the limits of possible cure has been demonstrated. The number of patients who survive without evidence of continued growth of the neoplasm is, then, small. These experiences have been discouraging to surgeons and internists alike and have resulted in a fatalistic attitude toward the problem in the minds of many internists and general practitioners. Such an attitude is not proper because it will inevitably lead to delay in the treatment of unexplained pulmonary lesions, and it is not justifiable because the opportunity for early treatment and increase in numbers of cures of bronchogenic carcinoma does exist and is a responsibility of the medical profession.

Certain established facts should be borne in mind: (1) Lung cancer occurs frequently in persons past the age of 40 years and occasionally during the fourth or even the third decade of life. (2) The lesion may arise in the periphery of the lung where, for varying periods of time, it gives rise to no symptoms, or it may originate in the larger hilar bronchi whence involvement of mediastinal lymph nodes may be widespread when symptoms are of a mild nature or of short duration. (3) The only effective method of treatment of bronchogenic carcinoma available at the present time is surgical excision. (4) The most effective method of detection of pulmonary lesions is the x-ray film.

The responsibility for improvement in the treatment of carcinoma of the lung is chiefly that of the average practicing physician, i.e., the internist and general practitioner, rather than the thoracic surgeon. The rapid improvement in techniques of anesthesia has contributed much to the safety of thoracic operative procedures. Radical pneumonectomy, consisting of the unhurried and extensive dissection of the mediastinum, is now accepted as a procedure which can be performed with little operative risk to the patient who is properly chosen and safeguarded before and after surgery. As with cancer of the breast, the determining factor as regards cure of the malady is dependent upon the surgeon's ability and opportunity to perform excision of the lung with its contiguous lymph nodes and vessels en bloc and

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in such a manner that the incision is everywhere extended through tissues beyond the limits of the invading growth.

Time is, therefore, of prime importance, and although many patients with lung cancer are beyond effective help when they first seek advice, many are not and can be cured if surgical therapy is not delayed. It follows that oftentimes the most effective and indeed the most important physician who is consulted by the patient is not the thoracic surgeon but rather the first doctor who learns that a pulmonary lesion is present.

The statement, "There are no early symptoms of carcinoma of the lung" has appeared in recent writings more than once. This is true in many cases. It must be emphasized, however, that the symptoms which do occur are too often ignored or regarded lightly by the patient and his physician. The symptoms which are produced by the growth are often those which are commonly associated with the common respiratory infections and, indeed, the growth of the tumor may be accompanied by infection. The patient who assumes that his illness is nothing more than a common cold or "the flu" and who, because he has recovered from such an illness in the past, fails to seek medical aid deserves no criticism for his action. If, on the other hand, he does consult his physician because he habitually does so or because he feels that his present illness differs in some way from previous similar ailments, the doctor must assume a grave and great responsibility. Too often such a patient is examined in a cursory fashion or not at all and is given an antibiotic or chemotherapeutic agent. Thus, in at least occasional instances, the chance for early diagnosis and effective treatment of bronchogenic carcinoma may be lost. If mild infection has been present in the respiratory tract, the patient may feel better and even if he does not, the psychologic "lift" which he may obtain from his visit to the doctor will often sustain him until, when he again seeks aid, the true nature of the lesion is all too apparent.

The thorax, because it contains air, lends itself admirably to roentgen examination, which can be obtained easily, quickly, and inexpensively. The general "routine" examination of any patient is as incomplete without the chest film as without the urinalysis. Certainly any adult who complains of symptoms referable to the respiratory system should have a chest roentgenogram and this without delay. The person whose symptoms are referable to the abdomen is often promptly referred to the radiologist for gastrointestinal examination. It is surprising that the complaints of the patient with a mild respiratory infection are so often considered lightly by the consulting physician.

The opportunity for the discovery and cure of early bronchogenic carcinoma is even greater when the lesion has arisen in the parenchyma of the lung and is then discovered by roentgen examination before it has produced symptoms. The use of Mobile X-ray Units employed by the Public Health facilities of most states is resulting in the discovery of numbers of such lesions. The incidence of this finding can be and is being added to by the more frequent routine chest x-ray examination of all patients at the time of their admission to hospitals and by the periodic roentgenogram of all patients by doctors in their office practices.

Excision of peripheral pulmonary lesions which are undiagnosed, particularly in the patient who is asymptomatic, apparently is as yet a new idea and an unacceptable one to many physicians. Surgical exploration of the breast, the abdomen, and of other areas of the body is undertaken without question or undue delay when there is a suspicion of malignancy. There is need for the same concept regarding the urgency for exact knowledge of the nature of unexplained nodular shadows found on the chest films of persons who have reached the age in which the incidence of lung cancer is high. Because of the fact that its appearance is not characteristic, the doctor who discovers such a lesion may be misled by a variety of circumstances and consequently be able to justify, in his own

mind, delay of the operative removal of the lesion. These circumstances include: His own reticence to advise an operative procedure which might prove to be "needless," his belief or hope that the shadow is caused by one of the several benign conditions which cannot be distinguished radiologically from cancer, his acceptance (often blindly and willingly) of a report from the radiologist in which the latter expresses the opinion that the lesion is inflammatory in nature, or, ignorance of the fact that by no other means can an exact diagnosis be made. The true nature of this type of lesion can be determined in only one way: by excision of the lobe or segment of lung within which the tumor is contained and pathologic examination of the excised specimen. The lesion cannot be visualized by bronchoscopy. Sputum is usually not available for examination. Skin testing with the antigens of tuberculosis or the fungi is interesting but of no help as regards the all important question of the existence of carcinoma. Cultures of sputum or of gastric washings for tubercle bacilli require too much time. Delay for short periods of time may often be proper if its x-ray appearance, or the presence of systemic symptoms or signs, suggests that the lesion may be of an acute infectious nature. Such waiting should rarely, if ever, exceed 2 weeks.

Much has been said and much research is in progress which is directed toward the causes and the prevention of lung cancer. The importance of these efforts is obvious, but until now they have probably had little if any effect upon the high incidence of death from this form of carcinoma. Our best hope for cure still must be based upon radical surgical extirpation of the growth. Hope for an increase in the number of cures by means of this method of therapy lies in the problem of earlier diagnosis in increasing numbers of patients. The opportunities for achieving better results are at hand but to be effective they must be accepted by all physicians and not by a scattered few with special interest in this problem.

A STUDY OF A LONG ACTING MUSCLE RELAXANT (TUBADIL) IN ANORECTAL SURGERY

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THE CONTROL OF PAIN after anorectal surgery continues to present a challenge. This article deals with the effectiveness of tubocurarine chloride, a controllable, slowly absorbed, skeletal muscle relaxant, used to reduce anal sphincter spasm and pain after hemorrhoidectomy. It was our purpose to try to eliminate the discomfort after these common surgical procedures.

It is generally believed that the source of pain following anorectal surgery is the accompanying spasm of the anal sphincter musculature. Thus far, locally injected anesthetics in oil have been unsatisfactory because of the possibility of infection and other reactions; the myriad of anesthetic ointments and creams attest to their ineffectiveness; and the hot sitz baths, although comforting, grant only temporary relief. The rationale of prevention of muscle spasm with curare-like preparations is based on the peripheral paralyzing action of these drugs at the myoneural junction. This action has been found to be of value in the treatment of painful spasm from traumatic injuries to the spine, shoulder, and in other orthopedic problems, as well as in anal sphincter muscle spasm.

Tubadil is a crystalline tubocurarine alkaloid slowly absorbed from a repository menstruum of white wax, chlorobutanol, and peanut oil containing 25 milligrams of active tubocurarine chloride pentahydrate per cubic centimeter. Effects are usually seen 45 to 60 minutes after deep intragluteal administration. The duration of action is reported to be 12 to 24 hours. Studies have shown that in the recommended dosage per kilogram absorption is so governed that the blood levels remain below 1 microgram, whereas 3 micrograms is the minimal level at which respiratory paralysis is noted. Among these patients receiving 100 individual injections of tubadil, there were no instances of respiratory embarrassment, although 2 patients had untoward reactions which will be described later.

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MATERIAL

This study was conducted upon patients undergoing hemorrhoidectomy in the Proctologic Service of the Jefferson Medical College Hospital. Procaine spinal anesthesia (70 mgm.) was used on all patients except for 3 who received pentothal sodium. Other anorectal operations, such as fistulectomy and excision of a fissure or abscess, are not included because of the variation in surgical trauma to the sphincter mechanism and subsequent differences in spasm and pain following surgery. The observed group consisted of 66 patients, 30 males and 36 females, from 24 to 66 years old, with an average age of 45.

METHOD

Tubocurarine chloride was used on alternate unselected patients who otherwise received identical postoperative care. The 33 patients in the treated group were given 0.5 milligram per kilogram of body weight of tubadil (usual dose 1.2 to 1.6 c.c. equivalent to 30 to 40 mgm. tubocurarine chloride). The first injection was

TABLE I.—AVERAGE NUMBER OF NARCOTICS REQUESTED BY PATIENTS IN FIRST 72 HOURS

	Treated group	*Control group*
No. of patients	33	33
Tubadil injections	99	0
Morphine, gr. ¼	1.5	2.7
Codeine, gr. 1	1.8	2.4
Per cent of patients requiring codeine after b.m. or enema	54	64
Sphincter spasm, per cent.	30	45
Subjective pain after exam., per cent	66	68

given immediately after return from the operating room, and was repeated 2 hours before examination of the anal canal on the first postoperative day and again 2 hours before the first bowel movement or enema on the third day.

At the beginning of this study tubadil was given 8 to 12 hours before examination of the anal canal and bowel movement, but its duration of effectiveness was found not to be as long as previously reported by Fuller. Therefore, the dosage schedule was changed as described previously allowing 45 to 60 minutes for absorption and 6 to 8 hours for expected duration.

Postoperatively, patients received one-quarter grain of morphine sulfate parenterally and/or 1 grain of codeine sulfate with aspirin at 4 hour intervals as requested by the patient. Accurate records were kept of the narcotic requirements of each patient in the treated and control groups for the first 3 days with specific notation of the necessity for narcotics after the first bowel movement. Sphincter spasm and anal pain were evaluated during daily wound dressings.

Subjective response to pain is a variable yardstick differing with the individual patient's emotional stability and past experience with pain. In this study more emphasis was placed on the objective evaluation of sphincter muscle spasm by a single observer, and the accurate recording of narcotics requested by the patient. The results are given in Table I.

There is a significant statistical difference between the narcotic requirements in the patients of the treated group as compared with the controls; this also applies to the objective evaluation of sphincter spasm and to a lesser degree to the percentage of patients requesting codeine after the first bowel movement or enema. On the other hand, both groups of patients complained almost equally of pain after examination of the anal canal.

COMPLICATIONS

There was no respiratory embarrassment in any patient receiving tubocurarine chloride. However, there were 2 patients originally in the control group who were so uncomfortable after hemorrhoidectomy that tubadil was administered on the third and fifth postoperative days respectively with resultant untoward effects. These cases are given in some detail because of the paucity of reported complications of tubocurarine in a repository menstruum.

The first patient, a 36 year old male weighing 190 pounds, was given tubadil after his first bowel movement after hemorrhoidectomy because of severe, unrelenting "rectal spasms." Ninety minutes after injection of 45 milligrams of tubocurarine chloride (1.8 c.c.), this patient developed diplopia and muscular weakness of the upper extremities with loss of fine co-ordination. During this period the patient experienced relief of pain and spasms (confirmed by digital rectal examination), but had no difficulty with respiration. One hour after injecting 1 cubic centimeter prostigmin 1:2,000, the diplopia disappeared and normal muscle function returned to the arms and hands.

The second patient was an alert, active 77 year old male who was given tubadil 5 days after hemorrhoidectomy because of severe anal pain refractory to one-quarter grain of morphine, 100 milligrams of demerol hydrochloride, and sitz baths. This patient weighed 178 pounds but because of his age was given only 1.4 cubic centimeters of tubocurarine chloride (35 mgm.) instead of 40 milligrams as calculated by weight. Thirty-five minutes after injection, he developed diplopia and marked muscle weakness in all extremities. He lay flat in bed unable to move his legs. Although he could raise his arms, he was unable to lift a glass to his lips and spilled the water on his chest in the attempt. It was difficult to evaluate relief of pain in this patient because of near hysteria accompanying profound muscle relaxation. Diplopia disappeared and normal muscle tone returned 3 hours after injection of 1 cubic centimeter of prostigmin.

These patients were both given the recommended dosage accurately calculated by body weight (the second patient received less because of his age), and neither was given a hot sitz bath immediately before or after receiving the drug. Assuming that there was no overdosage in these cases, it is possible that rapid absorption

from the menstruum produced untoward effects; although we have no blood level studies to confirm this. Lipow reported "diplopia and some inco-ordination in about 15 per cent of patients."

SUMMARY

Tubocurarine chloride in repository menstruum has been used in 33 patients undergoing hemorrhoidectomy. Narcotic requirements, anal sphincter spasm, and pain during examination of the anal canal and after the first bowel movement have been compared with a control group.

The treated group of patients in the first 72 hours following hemorrhoidectomy required an average of only 1.8 injections of morphine and 1.5 doses of codeine as compared to 2.7 and 2.4 respectively in the control group. There was less sphincter spasm in the group receiving the drug, but subjective pain was more difficult to evaluate accurately. Side reactions in 2 patients are described.

CONCLUSION

Tubadil is a slowly absorbed, long acting tubocurarine chloride muscle relaxant working at the peripheral myoneural junction. It reduces anal sphincter spasm and narcotic requirements after proctologic surgery, but both groups of patients complained almost equally of pain. Tubadil has a limited field of usefulness in alleviating pain following hemorrhoidectomy.

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FLEXIBLE SUMP-TUBE DRAIN

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Passive gravity drainage with Penrose or other drains is satisfactory for the drainage of small quantities of pus, blood, or other fluid. However, for the drainage of large quantities of fluid which accumulate as a result of biliary, pancreatic, urinary, or intestinal fistulas, passive drainage is inadequate. The cavity is incompletely drained, the skin is difficult to protect from irritating discharges, and the amount of drainage is not easy to estimate. Simple suction drainage may be inadequate consequent to the formation of a vacuum in the cavity being drained. Chaffin has compared suction drainage to the sucking of fluid from a sealed container filled with water. The sump drain described and advocated by Babcock (1, 2, 3), by allowing air to enter the cavity to break the vacuum, permits continuous and adequate suction drainage.

Sump drainage has not been widely adapted because the drains available have been rigid and uncomfortable. Chaffin and, more recently, Cleland have designed flexible suction drains that embody the sump principle.

We have used the latex tube shown (Fig. 1) and found it satisfactory. The tube is soft, flexible, and it embodies the sump principle. Suture tabs permit the fixing of the tube at any desired level. The suction and air vents are clearly marked on the tube to prevent error. The air vent can be utilized for the instillation of solutions into the cavity for irrigating or for aspirating fluid for diagnostic purposes. The standard Gomco, Wangensteen, or Steadman suction apparatus will function satisfactorily for applying negative pressure to the tube.

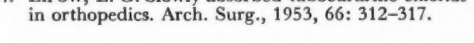

Fig. 1. Diagrammatic sketch showing the construction of sump-tube drain.

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THE RESULTS OF A QUESTIONNAIRE SURVEY OF COLOSTOMY PATIENTS

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THE ADDED BURDENS and change in living brought on by a colostomy operation are not considered as minor or simple. Neither should a colostomy operation be expected to cause extreme alterations of, or deep psychologic trauma to, the patient's life. The present report will attempt to sound a more cheerful note for colostomy patients and point out that poor colostomy control, colostomy gas and odor, long-standing urinary complications, loss of employment or work output, shattered economics, serious and frequent sexual curtailment, lessened travel and social activity, and general withdrawal from society are not, or need not be, necessarily frequent consequences. In addition, the every day care and routine management of the colostomy will be included as reported by the colostomy patients themselves.

METHOD AND MATERIALS

The data reported here are compiled from 92 completed, detailed questionnaires (Fig. 1) returned by patients who had a colostomy performed for carcinoma of the rectum. All had Miles' resection except 1 patient who had a colostomy and only x-ray therapy to the rectal lesion. Originally, 186 questionnaires were sent without selection of colostomy patients other than available addresses and evidence that the patient was still alive at the time of the mailing. Among the 186 patients contacted, 27 were reported as deceased, 23 were not reached because of incorrect or insufficient addresses, 3 sent in almost totally incomplete questionnaires, and 2 had had sigmoid resections without colostomy.

There were equal numbers of males (47) and females (45). The time since operation varied from 6 months to 27 years and 6 months. The majority represented a group evenly divided from 1 to 5 years since operation. The number of reports on patients surviving for 10 or more years was about equal to those living for less than 1 year after operation.

The majority of our questionnaires were filled out by people between 50 and 70 years of age with an age range of from 22 to 84 years. Twenty-five patients were less than 50 years of age. There was no tendency toward seclusion or reclusion among these colostomy bearers as evidenced by the fact that only 15 per cent lived alone, yet 27 per cent were widowed.

IRRIGATION OF COLOSTOMY

Daily colostomy irrigations were reported by nearly 65 per cent of the patients, every other day by 15 per cent, infrequent irrigations by 8 per cent, and none at all by 12 per cent of the group. One male patient irrigated twice a day. In the group who irrigated infrequently, several stated that this procedure was necessary only when they were constipated or in order to avoid irregular emptying from the colostomy. The reasons given by the 12 per cent for never irrigating included: pain, the messiness of irrigation, and more comfort if the colostomy is left alone.

It was interesting to note that of those who never irrigated, all but 1 were over the age of 60, and the majority of these were males. Five of the 6 people in the series who had colostomy established more than 10 years ago were among those who never irrigated.

For irrigation, the enema bag was preferred to the can, and the bathroom was the site of choice for irrigating. The time of irrigation was most often in the morning and the position was sitting down. Next in preference the patients chose the bedroom where they would sit in a chair with the bed pad propped on their lap. Four patients used the kitchen where ample water was available since they had no indoor plumbing. One patient used the bathtub and gave no more particulars. The remaining 20 per cent who did not sit down while irrigating were equally divided between standing and lying down. A few patients who lay down during irrigation, sat up when the

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UNIVERSITY OF WISCONSIN TUMOR CLINIC

Colostomy Questionnaire Part I

Your initials_____Age at present_____Month and year of operation_____
Sex M or F_____Single, Married, Divorced, Widowed_____
Residence; with husband or wife_____alone_____ relatives_____nursing home_____

How often do you irrigate your colostomy?_____ With a can or bag?_____
What time of day do you irrigate?_____ Where?_____
In what position are you when you irrigate?_____
What kind of tube do you use?_____How far do you insert it?_____
How much water do you use?_____Warm or cold?_____Do you add anything to the water?_____How long does it take to return (the water)?_____
What do you do while waiting for the water to return?_____
Does the irrigation clean you out completely?_____ What is the total time you need to care for your colostomy?_____Do you get up earlier?_____
Do you have pain or other difficulties from irrigation? Explain_____
Do you have special aids or practices you use while irrigating?_____
Please mention these aids or practices_____
Do you use any special cream or paste on your skin about the colostomy?_____
Do you shower or wash up after the colostomy?_____
Do you dilate the colostomy before you irrigate?_____ With glove?_____
Do you lubricate the glove?_____What fingers do you use?_____How far?_____
What covering do you place over the colostomy?_____

Are you bothered by spilling from the colostomy?_____ How often?_____Under what conditions do you spill?_____What precautions do you take to avoid spilling?_____ Are you bothered with gas escaping?_____
What do you do to prevent or correct gas?_____

Do drugs affect your colostomy function?_____Which ones?_____
Do you use laxatives?_____What kind?_____

Do illnesses upset the colostomy?_____Which ones?_____How do you manage these?_____
Are you bothered by odors from the colostomy?_____
What means do you use to prevent them?_____

Are you troubled with diarrhea or constipation?_____
Do you avoid foods or liquids that are troublesome?_____Name them_____
Which foods loosen your bowels?_____
Which ones bind up your bowels?_____

Do you try different foods other than given on your special diet?_____

Do you have to watch your weight?_____Gain or loss?_____
Have you decreased your social outings since the colostomy?_____
Do you have less company?_____Less visitors?_____Less travel?_____
Have you stopped community work, membership in clubs, etc.?_____
Do you stay at home more?_____Do you feel the colostomy is to blame?_____
Did the colostomy decrease your working ability?_____ How?_____
Did you lose your job because of it?_____How?_____
Did you quit working because of the colostomy?_____Why?_____
Is your income less now than before the colostomy?_____

Was it necessary to take a lower level of work?_____
Was your age an important factor in your change of work?_____
Is your husband or wife understanding about the colostomy?_____
Have you talked over the problem?_____Has your marriage suffered?_____
Did the operation damage your sexual power?_____ In what way?_____
Does the colostomy interfere with your sexual life?_____How?_____
Was the reason for your colostomy fully explained to you?_____
What reaction did you have when you heard you must have a colostomy?_____ _____How long did it take to adjust to it?_____
Were you depressed before or after surgery?_____How long?_____
Have you had pain in the rectal area?_____A full feeling?_____How long?_____
Are you still being checked up regularly by your doctor?_____

FIG. 1.

evacuation began. One patient spent the entire irrigating time on his knees.

The majority of the patients used rubber catheters or standard rectal tubes for irrigation. Two patients utilized glass tubes and 1 patient used a syringe. The rubber tubes were inserted anywhere from 1 to 24 inches into the bowel but, in the majority of cases, from 6 to 12 inches.

Half of the patients used 1 quart of irrigating fluid while about 10 per cent used less than that amount. The remaining 40 per cent used more than 1 quart, but only 2 patients used more than 2 quarts. Most patients preferred warm, plain, irrigating water while 2 used boiled water. About

one-fifth of the patients added soap, salt, soda, or combinations of these to the irrigation fluid. Both incomplete cleansing and rapid emptying time of the colostomy were reported by the majority of those who added soap to the water (8 of the 10 using soap). An arbitrary time of less than 5 minutes was considered as a rapid emptying time after the enema fluid was placed in the colon.

In 90 per cent of the patients the bowel began to empty at any time up to 1 hour after the enema was begun. This group was divided almost equally into those in whom the onset of return of the fluid was less than 5 minutes, one group between 5 and 30 minutes for the return, and 1 of 30 minutes to 1 hour. One male patient mentioned that following irrigation with up to 1 quart of fluid there was often no return from the colostomy.

About half of the patients who irrigated reported satisfactory results. Two-thirds of those who reported unsatisfactory results stated that they were not sure, they could not tell, or that the poor cleansing was only occasional. Therefore, only 15 per cent of those who irrigated reported that they definitely had improper cleansing, incomplete irrigation, or were never properly cleaned out. This percentage of failures seems understandable in a group including many patients who were elderly and of all degrees of intelligence.

Ten of the patients who reported that the irrigating fluid returned immediately after the enema tube was inserted or shortly thereafter also reported poor cleansing results. Eight of these 10 patients were among those who inserted the irrigating tube less than 4 inches. Complete cleansing did not seem to be correlated with the onset of emptying after an interval of 5 minutes had elapsed.

Two possible causes were suggested for the unsatisfactory cleansing results. The first was insufficient amounts of irrigating fluid, and in this study it amounted to using 1 pint or less of water. The second factor causing unsatisfactory cleansing results was the inadequate depth of insertion of the tube. Less than 4 inches was considered inadequate in this series after correlation of the cleansing results with the depth of insertion. It can be expected that those who allow the water to run out around the tube and from the colostomy stoma as soon as it is inserted will have poor irrigating results.

Three-quarters of the patients took an hour or less for total colostomy care. The remainder needed 1 to 3 hours with the exception of 1 patient who utilized 4 to 5 hours once a week to cleanse completely, using only 2 cups of water to irrigate himself daily.

Several patients mentioned that they experienced pain with irrigation, but the majority of these did not irrigate regularly. Some even volunteered the reason for the irregular irrigations as being pain. Nine patients who irrigated experienced occasional cramps, a bloated feeling, and colic from the irrigation. Five of these patients noted that pain occurred when the water flowed in too fast. One patient specifically mentioned he had pain if the tube kinked and if the fluid was prevented from draining out. This fact indicated that he left the colostomy tube in during the entire procedure.

Most of the patients complained that the colostomy stoma became sore and tender at intervals. Irritation from the pads was given as the reason for bleeding about the colostomy stoma by several patients. One female patient mentioned bleeding at the time of her menstrual period from the colostomy stoma edge, suggesting a vicarious type of menstruation.

Very few patients used any extra aids or special props during colostomy care other than the routine prescribed apparatus. One patient made use of the irrigating tube as a stimulator by inserting it a second time and thereby bringing on evacuation of the bowel. Another patient used a newspaper as a trough through which he channeled the effluent from the colostomy into the toilet. Still another used a rubber washer on the colostomy tube to seal in the water while irrigating.

CARE OF THE COLOSTOMY SITE

Half the patients used no medication about the colostomy area. KY jelly was preferred by the majority of the others. Also mentioned were zinc oxide, oil, talcum powder, and cold cream. Most of the patients cleansed the immediate area of the colostomy stoma after the irrigation but very few went as far as taking a complete shower. Eight people did nothing in the way of personal hygiene after irrigation and so stated.

Forty-six patients in this series answered the question on whether or not they dilated the colostomy. Of those answering, 15 rarely or never dilated. Among this group that neglected the

dilatation a significant number of colostomies were slow to empty or difficult to clean out as admitted by the patient (9 of the 15 patients). The only 2 reported cases of colostomy revision from this series of patients came from those who refused to dilate. Dilatation was carried out in most instances by introducing a rubber-gloved, lubricated, small finger first and gradually working up to larger fingers; 3 patients used no gloves.

More than half of the patients used the colostomy aluminum dome as a covering over the colostomy with or without fluff pads underneath. About 20 per cent used colostomy bags which were contrary to the recommendations by this hospital group. Many of these patients, however, were seen primarily elsewhere. Some had changed over of their own volition. A few patients used pad and dome during the day and the colostomy bag at night. Besides fluffs, facial tissues, paper towels, and toilet paper were used over the colostomy. Three patients specifically mentioned using no covering except their undergarments over the colostomy.

SPILLING FROM THE COLOSTOMY

Thirty-eight patients answered the question on spilling, and 21 of these reported that they never or seldom spilled. Fourteen reported a frequent or very frequent occurrence of spilling. Of this latter group, the majority blamed food as the cause or a portion of the cause of the spilling. They mentioned that it was the kind of food that they ate and not, necessarily, the amount. Three mentioned that spilling of the colostomy occurred after more than a quart and a half of irrigating fluid was used. Two stated that spilling occurred when there was incomplete emptying at the time of the irrigation earlier in the day judging from the fact that less fluid returned than the amount used to irrigate. Some patients also incriminated excitement, reaching, straining, or laughing as positive factors in spilling.

Precautions taken to avoid spilling were centered mainly around changing the diet, avoiding "stimulating" foods, or waiting longer for complete return of the enema. The kinds of food most often mentioned were cabbage, beans, raw fruit, dry fruit, sour items, beets, fats, and soda pop. Other precautions taken by the patients who spilled included: more pads, spending more time irrigating, switching to the colostomy bag, using "binding" drugs, or boiling the milk before they drank it. Two patients did nothing.

COLOSTOMY GAS

Fifteen patients mentioned that gas was troublesome. The majority in this series stated that avoiding gaseous foods such as cabbage, beans, and onions prevented the gas. The patients did not specify whether the gas was internal or emitted from the colostomy. They suggested as an antidote that a bland diet be substituted during the period that the bowel was upset. Other suggestions included the use of drugs such as mineral oil, an alkaline, and charcoal tablets. Others just irrigated more thoroughly the following day which cleared up the gas. Eight of the 15 who were bothered by gas were among those with poor irrigating practices such as insufficient amounts of irrigating fluid, shallow insertion of the irrigating tube, and failure to dilate the colostomy with the finger.

COLOSTOMY ODOR

Colostomy odors were a bother or were present in 35 patients. Among the 15 patients who used colostomy bags, 11 were bothered by odors. Most of these patients used hygienic means to prevent them. Several found that by avoiding chocolate, candy, or eggs in the diet, the odor was lessened. Other suggestions were perfume, room deodorizer, and various commercial brands of underarm deodorant placed on the colostomy covering. One patient mentioned the use of oral chlorophyll.

DIET AND WEIGHT

Eighty-five per cent ate foods other than those prescribed originally by their physician. About a fifth of the group stated that they ate everything that they wanted, while 10 per cent stated they ate little or nothing except that which was on the diet sheet. As could be expected, those patients who had recent colostomy operations conformed the closest to the restrictions of the diet sheet.

Seventy-three of the 92 patients gained up to 60 pounds postoperatively. Nine lost weight with no mention of the amount, and 10 per cent stayed the same. Only 1 patient mentioned the need of a diet to keep his weight down.

CONSTIPATION AND DIARRHEA

Constipation was reported by 7 patients and was controlled by the use of mineral oil. Diarrhea was a severe problem in only 5 patients. Food was mentioned as the biggest causative factor in diarrhea, and the list of offenders in order of frequency was beans, cabbage, sauerkraut, fresh

fruit, rich foods, raw or coarse foods, sugars, onions, spicy foods, and alcohol. The foods mentioned as causing or contributing to constipation were: cheese, boiled milk, potatoes, starches, fresh white bread, and chocolate. A fact of interest was that certain foods were mentioned as causative factors in both diarrhea and constipation. They were cabbage, strawberries, fresh white bread, milk, and starchy foods.

SOCIAL LIFE, TRAVEL, EMPLOYMENT

Nearly all of these people stated that following the colostomy operation they had less social life. A majority of the patients had fewer visitors, travel, and community work, and many spent more time at home. Sixty-two patients commented on the question of whether or not they blamed the colostomy for the changes in their social life. Only 19 answered yes and 8 stated somewhat. This means that less than one-third of the total patients or less than one-half of those answering this question actually pinned the blame of their decreased social life and activity on the colostomy.

In terms of work capacity, 30 patients stated it was decreased, 14 mentioned that they did less heavy work now, and 2 stated that they could do more. The latter 2 were females, 1 doing housework and the other a farmer's wife who did combination housework and farmwork. When asked to give reasons for lessened work capacity, 5 stated that they tired too easily. Only 1 mentioned lack of control or the embarrassing escape of gas. Two stated that work caused abdominal pain. Three volunteered the information that since the colostomy took extra time to irrigate they had less free time in the morning to devote to work. Seven patients, all over 70 years of age, said that the reason that they could do less was their age.

Three patients lost their jobs because of the colostomy. One stated that the employer told him that he was no good after the operation. The other 2 failed to comment. Nine patients quit work because of the operation. One was ordered to do so by his local physician. Odor was mentioned by 1 as the cause of his quitting work. Two said that they tired too easily and 1 noted that because he had an incisional hernia along with the colostomy he was not able to do physical labor.

Fourteen people stated that their income status was less since the colostomy operation. One patient specifically mentioned that he had a better job and only 8 stated that they had a lower level of work or part-time work. Of interest is the fact that 2 patients volunteered that they worked only in the afternoon in order to leave the morning free for colostomy care.

The specific question was asked in the survey whether age was a factor in their decreased work capacity, their lower income, or their part-time work, if such was the case. Sixteen individuals stated yes and 5 stated no. The latter 5 were age 65 or over. Again, we find that age has an important bearing on work, irrespective of the colostomy.

MARITAL EFFECTS

The greater majority of the patients gave credit to their spouses for being understanding. All had talked over the colostomy problem in detail at one time or another. Two stated that their marriage had suffered, while 3 stated that their marriage was somewhat affected. Of our entire survey group, there were only 4 divorced patients, 2 of whom stated that the colostomy had something to do with the divorce.

The sexual effects of the colostomy were handled by simple and frank questions. Twenty-one patients stated that the operation had caused changes of sexual nature. Only 9 patients refused to answer the question and 7 of these were females. Two people believed that there was slight change which gave a total of 23 who thought there was some change. Nine males complained that they had lost their sexual ability and 5 could not attain an orgasm (4 males). Two stated that they blamed the operation for their loss of sexual power because nerves had been cut. One female mentioned pain as the limiting factor in her sexual disability. Another woman stated that she had less energy. Additional complaints included a female who believed that since the operation the vagina was too small for coitus; another female stated that she derived less pleasure. Five patients answered the question about the effect on their sexual life by colostomy by stating that they were too old. This included a 52 year old female and a 66 year old man who added, "Actually, I can't tell."

A 40 year old female asked why sterilization was not carried out in conjunction with the abdominoperineal operation. She stated that since the operation made it almost impossible to fit a diaphragm due to the malposition of her female structures, conception was possible and danger-

ous. Therefore, she believed sterilization might well be indicated in her case. This was one of the many suggestions introduced by the interviewed patients.

Five affirmative answers were reported on the question of whether or not the colostomy mechanically interfered with sexual life. Two stated that the colostomy was bothersome, 1 female mentioned her husband feared it, and another commented that there was odor, the threat of possible spill, and the inconvenience of the colostomy dome and pads.

REACTIONS TO THE COLOSTOMY

Only 7 patients stated that the operation was not fully explained to them. Two additional patients stated that it was explained "somewhat" and did not elaborate. There were 2 patients who mentioned that they did not understand what the term colostomy meant and hence did not comprehend the full implication of the operation.

When the patients were told that the colostomy was necessary, 25 patients reported that they were resigned to it as being inevitable to save their lives. Sixteen admitted that they were quite depressed initially. Open fear was mentioned by 9 patients, while 3 stated that they were actually despondent. Other reactions to the announcement that a colostomy operation was needed included the fact that they were glad to be helped, they were stunned, or they believed it was not necessary at their age or with their special type of disease.

ADJUSTMENT TO COLOSTOMY

Fifty-five patients in all commented on their reactions to the announcement that colostomy was necessary. Fifty-one answered that they were adjusted to the situation in a short time. Twenty-five of these patients stated that they adjusted in as short a time as 3 months or less. Only 4 mentioned that it took a year or more to get over the fact they had to have a colostomy. Four patients of the entire series of 92 were still depressed at the present time. Many stated that the depression left when they regained their strength, got the colostomy in working order, or when they began gaining weight, and it was then that they were convinced that the colostomy was worth while.

POSTCOLOSTOMY DIFFICULTIES

Perineal pain was reported as persisting to the present time in 15 patients. Three mentioned pain while sitting firmly or on hard surfaces and 25 patients mentioned a full feeling in the posterior area early in the postoperative period. There was no mention of urinary difficulties in any of the complaints or remarks of the patients. Although it is known that postoperatively at least a third of abdominoperineal patients of this hospital experience urinary difficulties, from all reports, the majority of the serious ones are cleared up by the end of 6 months to a year.

FOLLOW-UP CARE

Sixty-six patients indicated that they were still visiting their doctors at intervals of 1 year or less. Only 4 patients failed to answer this question. Twenty stated that they had had check-ups for the first 3 months to 1 year but none since. Of interest was the fact that the majority of the patients who saw their doctors irregularly or not at all had trouble with irrigation odor, and spillage from the colostomy and this group also included most of those who did not irrigate at all.

DISCUSSION AND SUMMARY

In summarizing the questionnaire findings on attitudes and reactions to the colostomy operation, it was difficult for us to find psychiatric or biosocial abnormalities. There was no evidence to support gross alterations in the personality or behavior pattern of these postoperative colostomy patients. There was no mention or hint by the patients in the entire series of psychotic or neurotic tendencies. The occupational changes by decreased work capacity or decreased income seem to be quite logical on the basis of the fact that 75 per cent of the patients were over 50 years of age and, more significantly, 46 per cent were over 65 years of age.

The decreased sexual activity and the increased sexual difficulties in several of these patients may well parallel the expected decreased autonomic control resulting from the sacrifice of nerves in order to complete such a thorough operation. Most complaints were construed by the author as being organic in nature rather than suggesting psychic disturbances.

It seemed obvious that lack of medical follow-up or poor patient co-operation with the physician resulted in poor irrigating techniques. These include shallow depth of insertion of the irrigating tube, insufficient amounts of irrigating fluid, and refusal to follow a regular, routine, irrigating schedule and could be fairly easily corrected.

We found very little in the way of practices or rituals along with the irrigation. There were no fetishes or self-imposed religious practices other than an occasional prayer during the irrigation which we could not find to be linked with the actual bowel cleansing itself. Spillage was not a major factor to be feared nor a catastrophic accident according to the views of these patients. Most of the colostomy group seriously attributed their difficulties to diet or poor irrigation techniques and took steps to correct them. They were most often successful in straightening out abnormalities of the colostomy by simply changing their eating habits or by the selection of different foods.

The age group of the patients, and especially the fact that colostomy and abdominoperineal operations occur most frequent past the age of 60, accounted for many of the difficulties experienced by our patients. Although our survey encountered the usual female resistance to answering personal questions, there were enough answers from the 45 females who responded to the questionnaire to give us some indication that their problems were not manifest.

The very low incidence of postoperative depression, neurosis, or fears was indicative that the patient adjusted rapidly and made a quick recovery to a near normal status, especially when he saw proof of the worth of the colostomy.

CONCLUSION

We of the Cancer Research Hospital, Tumor Clinic, are unanimous in our belief that a colostomy is a high but worth-while price to pay to live. We have found that the colostomy patient can adjust rapidly to his new hygienic routine, if adequate educational preparations are afforded to him prior to his discharge postoperatively. We must stress the importance of the interval follow-up examination and the opportunity for the patient to discuss the problem with the doctor. We have found the colostomy patient extremely cooperative and anxious to succeed, and, hence, can be placed in the category of satisfied, as well as satisfactory, cases.

THE SURGEON'S LIBRARY

Reviews of New Books

THE FIVE PREVIOUS EDITIONS of the volume entitled *The Management of Fractures, Dislocations, and Sprains*[1] have received due acclaim. This edition is equally worthy of acclaim. As a reference text on trauma and sequelae of trauma, it fulfills the needs of the most exacting practitioner, not only for its completeness, but also for its clarity of style and emphasis on sound principles of therapy and diagnosis. The chapters on trauma of the skull and brain and on fractures of the jaw and associated facial bones, which appeared in earlier editions, have been taken out of the present edition since care of these injuries has become highly specialized and usually is not handled by the average practitioner. However, expansion of the chapters on compound and war wounds, injuries of the hip and spinal column, and injuries of the ankle more than compensates for the deletion.

Throughout the book, care is taken to present each item carefully and clearly, not only in the text but also by appropriate illustration. If any one aspect of the volume can be singled out, it is that of the illustrations. Frequently they show the part immediately before injury and before treatment, as well as subsequent stages in therapy and convalescence. Suggested pieces of apparatus of equipment are shown, and various therapeutic maneuvers are outlined by well conceived sketches. In short, the many illustrations and excellent captions make it possible to gain much knowledge simply by using the volume as an atlas. Care is taken to integrate the illustrations into the text so as to produce continuity.

Physically, the volume presents an attractive appearance, and is securely bound. The paper is of high quality, and the large type used makes for easy and fast reading. Margins are ample, illustrations are well placed, and arrows are used generously to denote salient features of the illustrations. The index and table of contents are full and complete, making possible ready reference to any desired item. Bibliographic references are few, but are recent when used.

In the final analysis it is apparent that this edition will continue to hold the high place obtained by the previous editions. As a reference text, as a study text, or as a teaching guide, this volume should be widely and enthusiastically accepted.—*Einer W. Johnson, Jr.*

[1]THE MANAGEMENT OF FRACTURES, DISLOCATIONS, AND SPRAINS. By John Albert Key, B.S., M.D., F.A.C.S., and H. Earle Conwell, M.D., F.A.C.S. 6th ed. 1168 pages, 1123 illustrations. $20.00. St. Louis: C. V. Mosby Co., 1956.

IN THE PAST DECADE three outstanding texts in neuro-ophthalmology have been published: Walsh's *Clinical Neuro-ophthalmology*, Vol. IV of Duke-Elder's *Text Book of Ophthalmology*, and the first edition of the book here reviewed, *Neurology of the Ocular Muscles*.[2] Although the first two texts mentioned contained 1,500 and 1,000 pages respectively, it was to the 200 page monograph by Cogan that the student turned for information in the field of the ocular muscles. This preference was due to more than a desire for a "quick answer"; it was because of the author's careful presentation of anatomic data and clinical material culled from his active research laboratory and hospital service. He has transferred this personalized approach *in toto* to the second edition and has made several valuable additions. He has expanded the original 6 page introductory chapter on the characteristics of the extraocular muscles to 20 pages and has included a discussion of intrinsic diseases of muscle. In keeping with the advances in knowledge of the function of the cerebellum, the section on this structure has been increased 50 per cent and has been dignified by a chapter of its own.

Over 300 references have been added to make a total of over 1,100, certainly the most comprehensive bibliography extant. Lastly, a word should be said about the beautiful color plates that form the frontispiece. These and their accompanying explanatory diagrams alone make the purchase of the second edition mandatory for all those who own the original text.

For those to whom this second edition will be an introduction to Cogan, a delightful treat is in store.
—*David Shoch.*

THE VOLUME entitled *Manual of Recovery Room Care*[3] has been written by members of the surgical staff of the New York Hospital-Cornell Medical Center. It is designed as a teaching and reference manual for those responsible for care of the postoperative patient.

A part of the book is devoted to the organization, administration, staffing, and equipment of the recovery room. The major portion, however, is devoted to the management of the patient following proce-

[2]NEUROLOGY OF THE OCULAR MUSCLES. By David G. Cogan, M.D. 2nd ed., 296 pages, 86 illustrations. $8.50. Springfield, Ill.: Charles C Thomas, 1956.

[3]MANUAL OF RECOVERY ROOM CARE. By John M. Beal, M.D. 111 pages, 24 illustrations. $3.75. New York: The Macmillan Co., 1956.

dures of general surgery or those of the general specialties and emphasizes early detection of unfavorable trends, methods of prevention, and treatment of complications. The book stresses the value of co-operation of surgeon, anesthetist, and nurse in this period of patient care.

This book will be of value to all who are responsible for the activities of the recovery room.

—*W. Harrison Mehn.*

UNDOUBTEDLY, Shelia Sherlock's work on *Diseases of the Liver and Biliary System*[4] is one of the most comprehensive volumes on liver disorders that has been published in recent years.

Certainly, the Argentine surgical group could make no better choice in transcribing it in their native tongue. The volume as they present it is a definite improvement over the original publication as far as paper stock, binding, and size are concerned. A much more presentable and readable text is forthcoming and complements Sherlock's English printing of March, 1955. The subject matter is a verbatim translation and is divided into two main headings: the first one is devoted to the liver and its disorders, and the second concerns investigations which center around the biliary tract.

The book is progressive in its perspective dealing with simple and apparent topics in the beginning chapters and dealing ultimately with the serious subjects of infections, cysts, and tumors.

The tone of the book is that of a didactic text, giving the historical features of a disease, its clinical findings, complications, diagnosis, differential diagnosis, and treatment. Each heading is well handled but not exhaustively. For this reason *Diseases of the Liver and Biliary System* makes an excellent and scholarly textbook. By bringing such a work before the Argentine profession a great service has been done especially for the younger members of that country's surgical group.

—*Stephen A. Zieman.*

THE EXCELLENT MANUAL *Colposcopy*[5] covers, in careful detail, the subjects of colposcopy and colpophotography. The technique of colposcopy is outlined and the advantages of using a mercury lamp are described. The description of the findings is explicit and, in conjunction with the beautiful color photographic plates, makes this manual most useful for those who wish to compare their experiences with that of Hinselmann. A classification of atypical cervical epithelium utilized by the author delineates his thinking on the subject of carcinoma of the cervix. Treatment is presented in a brief but concise manner.

The plates, many in color, are invaluable to all workers in this field since they depict so clearly all the representative lesions. The manual will undoubtedly increase the interest of colposcopy in this country.

—*John I. Brewer.*

[4]ENFERMEDADES DEL HIGADO Y DE LAS VIAS BILIARES. By Shelia Sherlock, M.D., (Edin.), F.R.C.P.(Lond.). Prólogo by Norberto M. Stapler. 832 pages, 231 illustrations. $4.00. Buenos Aires: Editorial Vergara, 1956.

[5]COLPOSCOPY. By Prof. Dr. Hans Hinselmann. With a contribution on Colpophotography by Dr. Albrecht Schmitt. 48 pages, 38 pages of illustrations, mostly colored. Wuppertal, Germany: Verlag W. Girardet, 1955.

THE FIVE VOLUMES of *World Trends in Cardiology*[6] are a compilation of papers and panel discussions presented at the Second World Congress of Cardiology in Washington, D. C. over 2 years ago (September 1954). The individual volumes range in length from 65 to 193 pages and carry the following titles: *I. Cardiovascular Epidemiology, II. Cardiovascular Surgery, III. Blood Volume and Contractile Protein in Heart Muscle, IV. Cardiovascular Diagnosis and Therapy,* and *V. Instrumental Methods in Cardiac Diagnosis.*

These titles indicate the wide range of subjects touched upon by the impressive number of contributors (97) who were drawn from all parts of the world. As might be expected, none of the subjects are dealt with thoroughly though trends, as the title suggests, become discernible in these various fields.

There is apparently no editor-in-chief for the entire project so that style varies considerably among the volumes. In general, however, the presentations are either panel discussions or rather brief papers summarizing important topics. Some volumes such as the one on cardiovascular surgery contain only panel discussions. This method of presenting several authorities to an audience in the hope that some stimulating discussion and enlightening debate will come forth with but little troublesome preparation has become popular and occasionally quite effective at meetings. When these discussions are recorded by a stenotypist and then printed with minimal editing, it is an easy way to make a book, but it is usually not good reading. These volumes are no exception. The best parts are the organized essays by one author.

If it is possible to buy individual volumes of the set, I think that Volume I on cardiovascular epidemiology and Volume III on blood volume and contractile protein in heart muscle would be the best ones to have. In Volume I there are a number of good papers on the epidemiology of atherosclerosis. Keys, one of the editors, with P. D. White, has two articles summarizing his important work on the subject and some additional more recent material in an appendix. Thomas' article which deals largely with what has been learned from the generalized Schwartzman reaction is excellent for those, like the reviewer, who are not well acquainted with the work. In Volume III the first 2 articles, one by Burton which is principally concerned with the skin circulation and one by Guyton on the venous return to the heart, are both worthy of study. Following these are several good articles on blood volume measurements and then a concluding section by Visscher, Mommaertz, and Bing on the contractile protein in heart muscle which is excellent —at least for the beginner. The remaining 3 volumes did not impress me as favorably though all of them have good sections. In the volume on cardiovascular surgery, the statistics presented by Gibson on a review of operations done in 15 cardiac centers are interesting. The volume is out-of-date in a number of matters, however, too brief for the subject, and poorly edited in some parts (e.g., misspelling of names). The best panel discussion is probably the one in Volume IV on rheumatic heart disease. In Volume V on

[6]WORLD TRENDS IN CARDIOLOGY. Edited by Ancel Keys, Paul D. White, Helen B. Taussig, Arthur S. Cain, Jr., and Louis N. Katz. Five volumes. New York: Paul B. Hoeber, Inc., 1956.

instrumental methods the reader can learn something about the wide variety of diagnostic techniques now employed in cardiology. I would like to call attention, particularly, to Burchell's article on dye-dilution curves for it is an excellent introduction to this one particular technique. —*Floyd J. Lewis.*

VOLUME II of Rob and Smith's *Operative Surgery*[7] is an excellent companion number to their first publication, and completes the material on the abdomen. Following the previous plan, the 22 chapters are presented by a group of British master surgeons chosen for their particular knowledge of a subject. Each chapter includes a concise discussion of the indications for the procedure, preoperative preparation, anesthesia, position of patient, postoperative care, and complications. Added to the superb step by step illustrations of the operations the information available is of such wide value as to make both volumes a most desirable addition to every general surgeon's library. The main section divisions of Volume II cover hernia, appendix, mesentery and peritoneum, spleen, and operations for portal hypertension, pancreas, biliary system and liver, small intestine, and large bowel. Some idea of the tremendous amount of material offered will be apparent from the brief comments to be given, which do not cover all chapters.

Belsey repairs esophageal hiatus hernias through a transthoracic approach and makes a strong point for restoration of the esophagogastric angle and the consequent preservation of a valve at the cardia. Rodney Smith, on the other hand, favors the abdominal approach, and in preparation for the operation emphasizes the importance of weight reduction in the obese which often cures the symptoms and obviates the need for surgery.

Inguinal hernia is extensively covered in all its variations, and most procedures illustrated are those done in this country. The Cooper's ligament type of repair is not thought highly of because of the tension produced when the medial structures are pulled down to this unyielding fascial ridge. A snug apposition of tissues about the cord at the internal inguinal ring is strongly recommended. A sliding hernia involving the cecum or sigmoid is handled simply by carefully separating the bowel from the hernial sac and returning it to the abdominal cavity, after which the neck of the sac is closed and the excess excised in the usual manner. No mention is made of the unnecessarily complicated two incision method of handling a sliding hernia as advised by some surgeons in this country. Sir Cecil Wakeley well covers the rare hernias of the retroperitoneal, linea semilunaris, obturator, lumbar, sciatic, supravesical, and urinary bladder areas.

Appendectomy is described in all its variations by Patrick FitzGerald who also presents the treatment for appendix and pelvic accumulations of pus. Subphrenic abscess procedures, which certainly need review by the occasional operator in this area, are beautifully illustrated by H. R. S. Harley. The stimulating subject of portal hypertension, operative ligation of acutely bleeding esophageal varices, splenorenal and portacaval anastomoses, and esophageal and gastric transection for bleeding esophageal varices is thoroughly covered by R. Milnes Walker.

Many valuable chapters on the pancreas are contributed by Rodney Smith who discusses pancreatoduodenectomy, total pancreatectomy, excision of the body and tail of the pancreas, conservative resections for tumors around the ampulla of Vater, biliary short circuiting for obstructive jaundice, excision of pancreatic islet cell tumor, cystic tumors of the pancreas, operations for pancreatic fistula, and operations for acute and chronic relapsing pancreatitis.

Rodney Maingot's section on the biliary system and liver is most complete, portraying the field from cholecystostomy to repair of severed or strictured bile ducts. Included under the material of the small intestines are jejunostomy, ileostomy, neonatal obstructions, resection and anastomoses, ileosigmoidostomy, ileorectal anastomosis, excision of Meckel's diverticulum, intussusception, diverticula and innocent tumors, and treatment of external intestinal fistulas. The chapters on the large bowel are equally complete, covering sigmoidoscopy, cecostomy, colostomy, closure of colostomy, right hemicolectomy, partial colectomy with anastomosis, obstructive resection, total colectomy, operations for volvulus of the large bowel, perforated diverticulitis, and operations for diverticulitis with and without vesicocolic fistula.

As a reference upon operative surgery, the 2 volumes by Rob and Smith should be in the library of every medical school and hospital in this country. They will be clearly instructive, particularly to the surgical resident building up his technical craftsmanship. For the practicing surgeon there are never too many current books on hand, and daily some procedure needs reviewing. An excellent reference book in his library is most valuable, and the material offered in these 2 volumes by master surgeons covers such a wide range that frequent use is inevitable. Such books give the greatest satisfaction. —*Walter G. Maddock.*

THE UNIQUE BOOK *Atlas of Tumors of the Nervous System*[8] bespeaks the rich experience of its authors, individually well known in the fields of neuropathology, neurology, and neurosurgery. While the emphasis is placed upon the main clinical features and the macroscopic and microscopic appearance of tumors of the central, peripheral, and autonomic nervous systems, there is also an account of metaplastic tumors, granulomas, the effects of increased intracranial pressure and brain edema, and the results of compression of the spinal cord. The text is brief, factual, and clearly written. Of the 277 illustrations, 233 are in color. The quality of every illustration is much above reproach, especially when one realizes the difficulty in staining, photographing, and reproducing on the printed page pathologic specimens of neural tissue. Compliments are due the artist, the photographer, and the printer. On enameled paper throughout and beautifully

[7]OPERATIVE SURGERY. ABDOMEN (complete). Under the editorship of Charles Rob, M.C., M.Chir., F.R.C.S., and Rodney Smith, M.S., F.R.C.S. Vol. II. 137–543 pages, illustrated. London: Butterworth & Co., Ltd., 1956.

[8]ATLAS OF TUMORS OF THE NERVOUS SYSTEM. By H. M. Zimmerman, M.D., Martin G. Netsky, M.D., and Leo M. Davidoff, M.D. 191 pages, 277 illustrations, 233 in color. $25.00. Philadelphia: Lea & Febiger, 1956.

bound, this book is a work of art and was, no doubt, a labor of love.

The authors have chosen to use the Bailey and Cushing tumor classification of 1926 which was based on the histogenesis of the nervous system. This method, though cumbersome on first acquaintance, has been in successful use for many years; it is almost universally accepted, it is easily understood, and it is all-inclusive, permitting even the classification of mixed-type tumors. The Cushing and Eisenhardt classification of meningiomas is not used, though in general the terminology used is the same as in that classification.

The appendix contains some interesting statistics on the incidence of the various tumors from two large series. There is also a useful table of synonyms for tumors. The bibliography is extensive and well arranged, and there is an adequate index. This book will attract many a neuropathologist and neurologist, and neurosurgeons at all levels of experience may profit by its use. Neurosurgical trainees will find that it is a "working atlas," not merely one to be admired for beautiful illustrations alone. —*John Martin.*

THE VOLUME entitled *Surgical Anatomy of Hernias of the Groin*[9] with its 488 pages of text and 237 illustrations is a labor of love and a very worthwhile contribution. An amazing amount of bibliographic and anatomic research has gone into its making. That hernia of the groin is one of the prices Homo sapiens must pay for being ". . . of far nobler shape, erect and tall, god-like erect . . ." is brought out in a well documented chapter on the comparative anatomy of the inguinal region. Instead of describing an inguinal or femoral canal with a posterior, anterior wall, the author describes, plane by plane, the region of the groin in its entirety. This type of exposé, illustrated by numerous excellent figures, gives a very clear understanding of the mechanics of the region of the groin and of the pathogenesis and pathologic anatomy of groin hernias. Fruchaud is to be congratulated for at least attempting to demonstrate the fallacy of such well perpetuated artefacts as the inguinal "ligament," the conjoined "tendon" or the "ligament" of Hesselbach.

The volume entitled *Surgical Treatment of Hernias of the Groin in the Adult*[10] with 386 pages of text and 210 illustrations is devoted to the author's technique of repairing hernias of the groin. The classical methods are discussed only to show their shortcomings. Fruchaud's technique for repair of these hernias—inguinal, direct and indirect, or femoral—is similar to that of C. B. McVay in that the transversus abdominis is sutured to Cooper's ligament medially and to the femoral sheath laterally. It differs in the following features:

The aponeurosis of the external oblique is incised along the lower border of the inguinal ligament of which the medial attachment is divided. The aponeurosis is reflected upward. Extensive mobilization and resection of the redundant peritoneum of the inguinal region are carried out. Reconstruction of the posterior inguinal wall is extended laterally by suturing the transversus abdominis to the iliac fascia lateral to the iliac vessels. The aponeurosis of the external oblique is sutured to the femoral aponeurosis deep to the cord, which is brought out laterally.

The operation is essentially the same for direct and indirect inguinal hernias and for femoral hernias since all are but varieties of inguinal hernias. Modifications of the procedure according to local anatomic conditions are discussed. —*René B. Menguy.*

THE LITTLE VOLUME *History of the American Board of Surgery 1937-1952*[11] is a factual presentation which recounts the organizational beginning of the American Board of Surgery in 1935, its origin in 1937, and its development and progress through the years, including 1953. The author was a member of the original Board and was the Board's Secretary-Treasurer from its beginning until his retirement in 1952. His 15 years of intimate association and his deep interest in graduate medical education eminently qualify Rodman to write this history. The book should appeal to all who have taken the Board's examinations for certification and those interested in the growing improvement in graduate medical education and specialty training. —*John B. Flick.*

A DETAILED TREATISE on the anatomy, physiology and pathology of the liver is given in the volume entitled *Liver; Structure and Function.*[12] There are 64 chapters, and more than 3,800 references to publications in the world literature are cited. The material is divided into 7 parts dealing with normal structure and function, pathologic phenomena in the hepatobiliary system, clinical study of hepatic function and structure, diffuse diseases of the liver, focal diseases of the liver, tumors of the liver and biliary tree, and internal and external environment of the liver.

The earlier chapters describe the gross and microscopic structure, and metabolic function of the liver. This provides a background for a discussion of jaundice, hepatic function as determined by liver function tests, and for diseases of the liver and the changes in the liver which accompany diseases of other organs.

The explanations in the texts are clarified and summarized by many charts and diagrams which greatly aid in making this a valuable reference book for students of this organ. There are many original photographs and photomicrographs and a variety of reproductions carefully selected from other published reports. It seems to the reviewer that the clarity of these illustrations and the captions beneath them are of unusual excellence.

In the final section of the book an addendum is added furnishing information more recent than that given in the bulk of the text and bringing the material up to date through 1956.

[9] ANATOMIE CHIRURGICALE DES HERNIES DE L'AINE. By Henri Fruchaud. With the collaboration of Anfre Leca and Paul Rene Breger. 488 pages, 237 illustrations. 6.000 fr. Paris: C. Doin & Cie, 1956.

[10] TRAITEMENT CHIRURGICAL DES HERNIES DE L'AINE CHEZ L'ADULTE; L'OPERATION DE L'HOPITAL SAINT-LOUIS D'ALEP. By Henri Fruchaud. With a number of collaborators. 386 pages, 210 illustrations. 5.500 fr. Paris: G. Doin & Cie, 1956.

[11] HISTORY OF THE AMERICAN BOARD OF SURGERY 1937–1952. By J. Stewart Rodman, M.D. 104 pages, illustrated. $3.00. Philadelphia and Montreal: J. B. Lippincott Co., 1956.

[12] LIVER; STRUCTURE AND FUNCTION. By Hans Popper, M.D., Ph.D., and Fenton Schaffner, M.S., M.D. 777 pages, 204 illustrations. $20.00. New York: McGraw-Hill Book Co, Inc., 1957.

It is a privilege to review this splendid book. As stated by the publisher it is a complete source book on the liver in health and disease. It will have a wide range of appeal and should be part of the library of every physician and scientist who is interested in the liver, whether he be a medical student, house officer, basic scientist, or clinician.

—*Frederick W. Preston.*

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

MALADIES DES VEINES; DIAGNOSTIC ET TRAITEMENT. By Claude Olivier. 600 pages, 342 illustrations. Paris: Masson et Cie, 1957.

RADIOLOGIE CLINIQUE DE L'ESTOMAC OPÉRÉ. By P. Porcher and P. Buffard. 660 pages, 507 illustrations. Paris: Masson et Cie, 1957.

CHIRURGIE; URGENCES CHIRURGICALES NEO-NATALES—LES HERNIES HIATALES. By M. Dubois, G. Laurence, P. Hillemand, J. L. Lortat-Jacob, R. Viguié, Y. Barré, and H. J. Bernard. 96 pages, 33 illustrations. Paris: Masson et Cie, 1957.

FUNDAMENTALS OF GENERAL SURGERY. By John Armes Gius, M.D., F.A.C.S. 720 pages, illustrated. $12.50. Chicago, Ill.: Year Book Publishers, Inc., 1957.

LE FOIE; ÉTUDES ANATOMIQUES ET CHIRURGICALES. By C. Couinaud. 530 pages, 256 illustrations. Paris, France: Masson et Cie, 1957.

OPERATIVE SURGERY. Edited by Charles Rob, M.C., M.Chir., F.R.C.S. and Rodney Smith, M.S., F.R.C.S. Vol. III. RECTUM AND ANUS; THORAX. 215 pages, illustrated. London: Butterworth & Co. Ltd., 1957.

SPONTANEOUS AND HABITUAL ABORTION. By Carl T. Javert, M.D. 450 pages, illustrated. $11.00. New York, N.Y.: McGraw-Hill Book Co., 1957.

PHYSIOPATHOLOGY OF THE RETICULO-ENDOTHELIAL SYSTEM. A Symposium Organized by the Council for International Organizations of Medical Sciences. Edited under the direction of B. N. Halpern by B. Benacerraf and J. F. Delafresnaye. 317 pages, illustrated. $9.00. Springfield, Ill.: Charles C Thomas, 1957.

ABDOMINAL TOTAL HYSTERECTOMY, A NEW TECHNIQUE, THE POSTERIOR APPROACH. By Frank Musgrove, M.D., M.R.C.O.G. 32 pages, illustrated. $2.25. Springfield, Ill.: Charles C Thomas, 1957.

SUPRAPUBIC CLOSURE OF VESICOVAGINAL FISTULA. By Vincent J. O'Conor, B.S., M.D., F.A.C.S. 53 pages, illustrated. $2.50. Springfield, Ill.: Charles C Thomas, 1957.

AN ATLAS OF CARDIAC SURGERY. By Jorge A. Rodriguez, M.D. 250 pages, illustrated. $18.00. Philadelphia: W. B. Saunders Co., 1957

SURGERY OF THE ANUS, ANAL CANAL AND RECTUM. By E. S. R. Hughes, M.D., M.S., F.R.C.S., F.R.A.C.S. 304 pages, illustrated. $10.00. Edinburgh and London: E & S. Livingstone, Ltd., 1957.

SCIENCE LOOKS AT SMOKING; A NEW INQUIRY INTO THE EFFECTS OF SMOKING ON YOUR HEALTH. By Eric Northrup. Introduction by Dr. Harry S. N. Greene. 190 pages. $3.00. New York: Coward-McCann, Inc., 1957.

THE PHYSIOLOGY OF INDUCED HYPOTHERMIA. Proceedings of a Symposium 28–29 October 1955, convened by the Division of Medical Sciences, National Academy of Sciences-National Research Council with the sponsorship of the U. S. Army, Navy, and Air Force. Edited by Robert D. Dripps, M.D. Publication 451. 447 pages, illustrated. $3.50. Washington, D. C.: National Academy of Sciences-National Research Council, 1956.

PLASTIC ARTERIAL GRAFTS. By W. Sterling Edwards, M.D. 126 pages, illustrated. $4.50. Springfield, Ill.: Charles C Thomas, 1957,

DEGENERATIVE CHANGES IN THE STERNOCLAVICULAR AND ACROMIOCLAVICULAR JOINTS IN VARIOUS DECADES. By Anthony F. DePalma, M.D. 178 pages, illustrated. $5.50. Springfield, Ill.: Charles C Thomas, 1957.

GYNECOLOGIC SURGERY AND UROLOGY. By Thomas L. Ball, M.D. With foreword by R. Gordon Douglas, M.D. Illustrated by Daisy Stilwell. 547 pages, 161 illustrations. $20.00. St. Louis: C. V. Mosby Co., 1957.

THE SURGICAL MANAGEMENT OF PULMONARY TUBERCULOSIS. Edited by John D. Steele, M.D. Introduction by Frederick A. Coller, M.D. Biographical Sketch of John Alexander by Cameron Haight, M.D. 213 pages, illustrated. $9.50. Springfield, Ill.: Charles C Thomas, 1957.

SURGERY; A GUIDE TO SURGICAL DIAGNOSIS AND TREATMENT INCLUDING TROPICAL SURGERY. By W. G. Kerr, M.D., F.R.C.S. Ed. 410 pages, no illustrations. $6.00 London: Oxford University Press, 1957.

PERIPHERAL NERVE REGENERATION; A FOLLOW-UP STUDY OF 3,656 WORLD WAR II INJURIES. Edited by Barnes Woodhall, M.D., and Gilbert W. Beebe, Ph.D. 671 pages, illustrated. Washington, D.C.: Veterans Administration, 1956.

SURGEONS ALL. By Harvey Graham, M.D. Foreword by Oliver St. John Gogarty. 459 pages, 29 illustrations. $10.00. New York: Philosophical Library, 1957.

TRAUMATOLOGIA DEL SISTEMA NERVOSO. By Angelo Chiasserine. 777 pages, illustrated. L. 9,000. Rome: Società Editrice Universo, 1957.

ESSENTIALS OF FLUID BALANCE. By D. A. K. Black, M.D., F.R.C.P. 127 pages, illustrated. $3.75. Springfield, Illinois: Charles C Thomas, 1957.

GASTRO-INTESTINAL OBSTRUCTION. By Meyer O. Cantor, M.D., M.S., F.A.C.S., and Roland P. Reynolds, M.D., F.A.C.S. With contributions by Clifford D. Benson, M.D., Robert E. L. Berry, M.D., and William A. Hudson, M.D. 565 pages, illustrated. $18.00. Baltimore: Williams & Wilkins Co., 1957.

PATHOLOGY. Edited by W. A. D. Anderson, M.A. F.A.C.P., F.C.A.P. 3rd ed. 1402 pages, 1294 illustrations and 11 color plates. $16.00. St. Louis: C. V. Mosby Co., 1957.

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NEW RESEARCH TECHNIQUES OF NEUROANATOMY; A SYMPOSIUM SPONSORED BY THE NATIONAL MULTIPLE SCLEROSIS SOCIETY. Edited by William F. Windle, Ph.D., Sc.D. Foreword by Frederick L. Stone, Ph.D. 98 pages, illustrated. $4.75. Springfield, Ill.: Charles C Thomas, 1957.

PNEUMOENCEPHALOGRAPHY. By E. Graeme Robertson, M.D. (Melb.), F.R.C.P., F.R.A.C.P. 482 pages, illustrated. $14.50. Springfield, Ill.: Charles C Thomas, Publisher, 1957.

CLINICAL ORTHOPAEDICS NO. 9. THE PATHOLOGIC PHYSIOLOGY OF METABOLIC BONE DISORDERS. Edited by Anthony F. DePalma, M.D. 353 pages, illustrated. $7.50. Philadelphia and Montreal: J. B. Lippincott Co., 1957.

PROGRESS IN GYNECOLOGY, VOL. III. Edited by Joe V. Meigs, M.D., and Somers H. Sturgis, M.D. 780 pages, illustrated. $15.50. New York and London: Grune & Stratton, 1957.

ANESTHESIA AND OTOLARYNGOLOGY. By Donald F. Proctor, M.D. 267 pages, illustrated. $7.00. Baltimore: Williams & Wilkins Co., 1957.

CURRENT SURGICAL MANAGEMENT; A BOOK OF ALTERNATIVE VIEWPOINTS ON CONTROVERSIAL SURGICAL PROBLEMS. Edited by John H. Mulholland, M.D., Edwin H. Ellison, M.D., and Stanley R. Friesen, M.D. 494 pages, illustrated. $10.00. Philadelphia and London: W. B. Saunders Co., 1957.

ONE SURGEON'S PRACTICE. By Frederick Christopher, M.D. 151 pages, not illustrated. $4.00. Philadelphia and London: W. B. Saunders Co., 1957.

OCCIPITOPOSTERIOR POSITIONS. By Edward L. King, A.B., M.D., F.A.C.S., F.A.C.O.G. 106 pages, illustrated. $3.75. Springfield, Ill.: Charles C Thomas, 1957.

HANDBOOK OF ORTHOPAEDIC SURGERY. By Alfred Rives Shards, Jr., B.A., M.D. In collaboration with Richard Beverly Raney, B.A., M.D. 5th ed. 725 pages, 214 illustrations. $9.75. St. Louis: C. V. Mosby Co., 1957.

THE PRINCIPLES OF THERAPEUTICS. By J. Harold Burn, M.A., M.D., F.R.S. 278 pages, illustrated. $5.50. Springfield, Ill.: Charles C Thomas, 1957.

THE CENTURY OF THE SURGEON. By Jürgen Thorwald. 432 pages, 66 illustrations. $5.95. New York: Pantheon Books, Inc., 1957.

Correspondence

AN ANALYSIS OF 105 RADICAL HYSTERECTOMIES AT THE FREE HOSPITAL FOR WOMEN—*A Correction.*

DR. ROBERT W. KISTNER wishes to call attention to several errors of omission and commission, as well as possible misinterpretation of data, which he made in his recent article that appeared in the June 1957 issue of the Journal on page 733. For clarity he would like to make the following corrections:

Credit for the surgical and pathologic classification of carcinoma of the uterine cervix (page 736) was given to Meigs and Liu (*Surg. Gyn. Obst.*, 1955, 100: 555–558). This should be corrected to read: "utilized by Meigs and Liu but first proposed by Meigs and Brunschwig (*Am. J. Obst.*, 1952, 64: 413–415)."

In the second paragraph of the Discussion on page 741, reference was made to the 1953 report of Meigs. In both clauses of this sentence, a phrase was misplaced. The sentence should be corrected to read: ". . . only 5 of 12 patients with positive nodes (of 66 operated on) in stage I, and 1 of 11 patients with positive nodes (of 34 operated on) in stage II were living 5 years at the time of this report."

Five year follow-up data are available on only 57 patients. It, therefore, was impossible to compare this particular facet with reports of other clinics regarding both surgery and irradiation. The article was presented primarily to review the indications and contraindications for surgery, complications, incidence of positive nodes, and fistulas, and to correlate the preoperative staging with the suggested postoperative classification. At a later date complete 5 year survival figures will be reported.

AMERICAN COLLEGE OF SURGEONS

DANIEL C. ELKIN, Lancaster, Kentucky, *President*

WILLIAM L. ESTES, JR., Bethlehem, Pennsylvania, *President-Elect*

PRELIMINARY PLANS FOR THE 43rd CLINICAL CONGRESS CONVENTION HALL, ATLANTIC CITY, NEW JERSEY OCTOBER 14 TO 18, 1957

BACK IN 1870, the seashore village of Atlantic City had a 1 mile long, 8 foot wide tideproof sidewalk of wood, authorized by the city fathers because a hotel proprietor complained that the incoming ocean tide swept over the marshland in front of his establishment, causing inconvenience to his guests and himself. Today, the world renowned Boardwalk is 5 miles long, and 60 feet wide, lined with hotels, shops, and amusement centers on one side, and the beach and ocean on the other. Proximity of the ocean to hotels is no longer considered an inconvenience, but rather a major attraction.

The American College of Surgeons held its first Atlantic City Clinical Congress in 1954, and returns with anticipation this year for its 43rd Congress, as countless doctors expressed their pleasure with the accommodations and atmosphere of this vacation city.

Headquarters for the meetings and exhibits will be Convention Hall, believed to be the world's largest, with some sessions scheduled at nearby hotels.

Advance Registration

Clinical Congress forms for advance registration, hotel accommodations, postgraduate courses, and transportation may be obtained from The American College of Surgeons, 40 East Erie Street, Chicago 11, Illinois.

No registration fee is charged Fellows if dues are paid to December 31, 1956. If dues are not paid, the fee is $20.00. No registration fee is charged Initiates or members of the Candidate group. No fee is charged Surgical Residents provided a note of identification signed by their chief of surgery or hospital administrator accompanies the advance registration form. Non-Fellows pay a $20.00 fee. Members of the Federal Services pay $10.00. The postgraduate course fee is $5.00, payable by everyone taking the course.

The official Registration Desks will observe the following hours: Sunday, October 13, 3:00 to 7:30 p.m.; Monday, October 14, 8:00 a.m. to 5:30 p.m.; Tuesday through Friday, 8:00 a.m. to 5:00 p.m.

Advisory Committee on Local Arrangements

Under the chairmanship of Dr. Royal A. Schaaf, the local committee has devoted much time and thought toward insuring the success of this meeting. Members of the committee follow:

ROYAL A. SCHAAF, *Chairman*
HERBERT D. AXILROD, *Secretary*
DAVID B. ALLMAN
HAROLD J. BAYER
RALPH J. BELFORD
RICHARD C. BEW
SAMUEL A. COSGROVE
BENJAMIN DAVERSA
ARTHUR DINTENFASS
MORRIS GOTTLIEB
ROBISON D. HARLEY
STUART Z. HAWKES
V. EARL JOHNSON
PHILIP J. KUNDERMAN
J. HAROLD MACART
ANDREW F. MCBRIDE, JR.
JAMES HENRY MASON, III

PAUL MECRAY, JR.
ANTHONY G. MERENDINO
HERBERT A. SCHULTE
CHARLES H. DET. SHIVERS
JAMES H. SPENCER
EDWARD W. SPRAGUE
G. RUFFIN STAMPS
HARRY SUBIN

The Press Relations Committee consists of the following:

J. MONTGOMERY DEAVER, *Chairman*
THOMAS C. ZULICK, JR., *Secretary*
WILLIAM W. L. GLENN
SAMUEL P. HARBISON
C. EVERETT KOOP
CHARLES L. MUNSON
LLOYD W. STEVENS
KENNETH W. WARREN
HAROLD A. ZINTEL

The Committee to Welcome Distinguished Guests is composed of:

RALPH J. BELFORD
STUART Z. HAWKES
PAUL MECRAY, JR.
JAMES H. SPENCER

Student Guests

Medical students from 36 medical colleges will attend the Congress this year as guests of the College. The student participation program was initiated last year as an educational contribution of the College by action of the Board of Regents. Students are selected by vote of their classmates, and medical colleges sending representatives to the Congresses will rotate each year. This year, the schools to be represented are located in Chicago, the eastern part of the United States, Canada, and Puerto Rico.

PRELIMINARY PROGRAM

Evening Sessions

PRESIDENT'S EVENING

Monday, 8:30—10:00 p.m., Ballroom, Convention Hall

DANIEL C. ELKIN, M.D., F.A.C.S., Lancaster, Kentucky; President, American College of Surgeons, *Presiding.*
Address of Welcome. ROYAL A. SCHAAF, M.D., F.A.C.S., Califon, New Jersey; Chairman, Local Advisory Committee on Arrangements.
Introduction of Guests. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia; Chairman, Board of Regents.
The Twelfth Martin Memorial Lecture.

CONVOCATION

Friday, 8:30—10:00 p.m., Ballroom, Convention Hall

DANIEL C. ELKIN, M.D., F.A.C.S., President, *Presiding.*
Procession. Initiates, Governors, Officers, Regents, and Guests.
Invocation. The Reverend HARVEY BENNETT, D.D., Atlantic City, Minister, First Presbyterian Church.
Presentation of Initiates and Conferring of Fellowships.
Conferring of Honorary Fellowships.
Installation of New Officers:
Second Vice President: R. ARNOLD GRISWOLD, M.D., F.A.C.S., Louisville, Kentucky.
First Vice President: FRANK GERBODE, M.D., F.A.C.S., San Francisco.
President: WILLIAM L. ESTES, JR., M.D., F.A.C.S., Bethlehem, Pennsylvania.
Address of the President: The Responsibility of Leadership. WILLIAM L. ESTES, JR., M.D., F.A.C.S.
Recession.

Annual Meeting—Board of Governors

Sunday, 9:00 a.m..—5 p.m., Belvidere Room, Traymore

CHARLES C. HIGGINS, M.D., F.A.C.S., Cleveland; Chairman, Board of Governors, *Presiding.*
Minutes of 1956 Annual Meeting of the Board of Governors. HOWARD H. BRADSHAW, M.D., F.A.C.S., Winston-Salem, North Carolina; Secretary, Board of Governors.
Report of the Chairman, Résumé of Interim Activities. CHARLES C. HIGGINS, M.D., F.A.C.S.

Report of the Executive Committee. HOWARD H. BRADSHAW, M.D., F.A.C.S.
Report of the President. DANIEL C. ELKIN, M.D., F.A.C.S., Lancaster, Kentucky.
Report of the Chairman, Board of Regents. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.
Report of the Director. PAUL R. HAWLEY, M.D., F.A.C.P., Chicago.
Report of the Committee to Continue the Study of Itinerant Surgery and Surgeons. GEORGE W. WALDRON, M.D., F.A.C.S., Houston, Texas, Chairman.
Report of the Committee to Continue the Study of Relationships Between the Medical Staffs and Governing Boards of Hospitals. JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia, Chairman.
Report of the Committee to Continue the Study of Diminishing Number of Service Patients for Training Programs. CARL A. MOYER, M.D., F.A.C.S., St. Louis, Chairman.
Report of the Committee to Study the Elevation of Standards of Smaller Hospitals and Care of Surgical Patient in Smaller Hospitals. CHARLES W. MCLAUGHLIN, JR., M.D., F.A.C.S., Omaha, Chairman.

ADJOURNED MEETING—BOARD OF GOVERNORS

Thursday, 3:30—5:30 p.m., Room 21, Convention Hall

CHARLES C. HIGGINS, M.D., F.A.C.S., Chairman; *Presiding.*
Report. Nominating Committee on Election of Regents.
Election of Regents of the College.
Report. Nominating Committee on Election of Officers, Board of Governors.
Election of Officers, Board of Governors.
Election of Nominating Committee, Board of Governors (1957–1958).
Announcement of Committees (1957–1958), Board of Governors.

Annual Meeting of Fellows

Thursday, 4:00—5:30 p.m., Ballroom, Convention Hall

DANIEL C. ELKIN, M.D., F.A.C.S., Lancaster, Kentucky; President, *Presiding.*
Report of the Chairman, Board of Regents. I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.
Report of the Chairman, Board of Governors. CHARLES C. HIGGINS, M.D., F.A.C.S., Chicago.
Report of The Director of the College. PAUL R. HAWLEY, M.D., F.A.C.P., Chicago.
Presentation of 1957 Distinguished Service Award. DANIEL C. ELKIN.
Report of the Committees on Nominations:
Election of Governors of the College; Chairman of the Nominating Committee of Fellows.
Election of Regents of the College; Chairman of the Board of Governors.
Election of Officers of the College; Chairman of the Nominating Committee of Fellows.
New Business.
Adjournment.

General Sessions

Monday, 10:00 a.m.—12 noon, Ballroom, Convention Hall

DANIEL C. ELKIN, M.D., F.A.C.S., Lancaster, Kentucky; *Presiding.*

TREATMENT OF METASTATIC BREAST CANCER

Moderator: CHARLES ECKERT, M.D., F.A.C.S., Albany, New York.
Collaborators: GEORGE E. MOORE, M.D., F.A.C.S., Buffalo; OLOF H. PEARSON, M.D., New York; BRONSON S. RAY, M.D., F.A.C.S., New York; WILLIAM B. SEAMAN, M.D., New York.

1:30—3:00 p.m., Ballroom, Convention Hall

INFLAMMATORY LESIONS OF THE GASTROINTESTINAL TRACT (EXCLUDING PEPTIC ULCER OR APPENDICITIS)

Moderator: STANLEY O. HOERR, M.D., F.A.C.S., Cleveland.
Collaborators: BENTLEY P. COLCOCK, M.D., F.A.C.S., Boston; BURRILL B. CROHN, M.D., F.A.C.P., New York; LAURENCE S. FALLIS, M.D., F.A.C.S., Detroit; L. KRAEER FERGUSON, M.D., F.A.C.S., Philadelphia.

3:30—5:00 p.m., Ballroom, Convention Hall

VISCERAL CAUSES OF BACK PAIN

Moderator: ROGER C. GRAVES, M.D., F.A.C.S., Boston.

Collaborators: J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston; REED M. NESBIT, M.D., F.A.C.S., Ann Arbor, Michigan; FRANK P. PATTERSON, M.D., F.A.C.S., Vancouver, Washington; LUCIAN A. SMITH, M.D., F.A.C.P. Rochester, Minnesota; HOWARD C. TAYLOR, JR., M.D., F.A.C.S., New York; JAMES C. WHITE, M.D., F.A.C.S., Boston, Massachusetts.

Tuesday, 1:30—3:00 p.m., Ballroom, Convention Hall

TUMORS OF THE THYROID

Moderator: DWIGHT E. CLARK, M.D., F.A.C.S., Chicago.

Collaborators: GEORGE CRILE, JR., M.D., F.A.C.S., Cleveland; JOHN C. MCCLINTOCK, M.D., F.A.C.S., Albany, New York; EDWARD ROSE, M.D., F.A.C.P., Philadelphia; PHILIP G. ROWE, M.D., F.A.C.S., Montreal.

3:30—5:00 p.m., Ballroom, Convention Hall

PORTAL HYPERTENSION

Moderator: SAMUEL P. HARBISON, M.D., F.A.C.S., Pittsburgh.

Collaborators: IAN AIRD, CH.M., F.R.C.S., London, England; ROBERT R. LINTON, M.D., F.A.C.S., Brookline, Massachusetts; JACK D. MYERS, M.D., F.A.C.P., Pittsburgh.

Wednesday, 1:30—3:00 p.m., Ballroom, Convention Hall

CHANGING ASPECTS OF SURGICAL INFECTIONS

Moderator: WILLIAM A. ALTEMEIER, M.D., F.A.C.S., Cincinnati.

Collaborators: ANTHONY R. CURRERI, M.D., F.A.C.S., Madison, Wisconsin; CHESTER W. HOWE, M.D., F.A.C.S., Newton Centre, Massachusetts; JOHN A. MONCRIEF, M.D., Atlanta, Georgia; EDWIN J. PULASKI, LT. COL., M.C., F.A.C.S., San Francisco; THOMAS S. WILSON, M.D., F.A.C.S., Edmonton, Alberta, Canada.

2:00—2:45 p.m., Renaissance and Venetian Rooms, Ambassador

THE BAXTER LECTURE: SOME ASPECTS OF WATER AND ELECTROLYTE EXCRETION

(The First Annual Lectureship in Parenteral Therapy.) ERNEST BASIL VERNEY, F.R.S., M.A., M.B., B.CH., F.R.C.P., Cambridge, England.

3:30—5:00 p.m., Ballroom, Convention Hall

GASTRIC ULCER

Moderator: GEORGE P. ROSEMOND, M.D., F.A.C.S., Philadelphia.

Collaborators: JOHN BRUCE, C.B.E., F R.C.S.E., Edinburgh, Scotland; HENRY L. BOCKUS, M.D., F.A.C.P., Philadelphia; J. HARVEY JOHNSTON, JR., M.D., F.A.C.S., Jackson, Mississippi; E. BRUCE TOVEE, M.D., F.A.C.S., Toronto; CLAUDE E. WELCH, M.D., F.A.C.S., Boston.

Thursday, 1:30—3:00 p.m., Ballroom, Convention Hall

BENIGN LESIONS OF THE ANUS AND RECTUM

Moderator: R. KENNEDY GILCHRIST, M.D., F.A.C.S., Chicago.

Collaborators: A. STEPHENS GRAHAM, M.D., F.A.C.S., Richmond; SAMUEL MCLANAHAN, M.D., F.A.C.S., Baltimore; NEIL W. SWINTON, M.D., F.A.C.S., Boston; ROBERT TURELL, M.D., F.A.C.S., New York; CHARLES WELLS, M.D., CH.B., F.R.C.S.(E), Liverpool.

3:00—3:30 p.m., Ballroom, Convention Hall

ORATION ON TRAUMA

Education in Trauma. HARRISON L. MCLAUGHLIN, M.D., F.A.C.S., New York.

Friday, 9:00 a.m.—12 noon, Ballroom, Convention Hall

WHAT'S NEW IN SURGERY?

HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis, *Presiding.*

Cardiovascular Surgery. ROBERT E. GROSS, M.D., F.A.C.S., Boston.

Plastic Surgery. BRADFORD CANNON, M.D., F.A.C.S., Boston.

Urology. SAMUEL A. VEST, M.D., F.A.C.S., Charlottesville, Virginia.

Gastrointestinal Biliary Conditions. CLARENCE DENNIS, M.D., F.A.C.S., Brooklyn.

Neurologic Surgery. WILLIAM H. SWEET, M.D., F.A.C.S., Boston.

Nutrition and Body Fluids. J. GARROTT ALLEN, M.D., F.A.C.S., Chicago.

Tumors. WARREN H. COLE, M.D., F.A.C.S., Chicago.

Surgical Specialties

GYNECOLOGY AND OBSTETRICS

Monday, 1:30—3:00 p.m., Ballroom, The Shelburne

CANCER AND PRECANCEROUS LESIONS OF THE VULVA

Moderator: S. B. Gusberg, M.D., F.A.C.S., New York.

Collaborators: C. Bernard Brack, M.D., Baltimore; Jason Haydel Collins, M.D., F.A.C.S., New Orleans; Joseph H. Pratt, M.D., F.A.C.S., Rochester, Minnesota.

3:30—5:00 p.m.

RADIATION INJURY TO FETUS OR MOTHER DURING PREGNANCY

Moderator: James F. Nolan, M.D., F.A.C.S., Los Angeles.

Collaborators: Richard H. Chamberlain, M.D., Philadelphia; Duncan E. Reid, M.D., Boston; Roberts Rugh, PH.D., New York.

Tuesday, 1:30—3:00 p.m.

SURGICAL CONDITIONS OF THE UTERUS AND ADNEXA DURING GESTATION AND THE PUERPERIUM

Moderator: Woodard D. Beacham, M.D., F.A.C.S., New Orleans.

Collaborators: Willis E. Brown, M.D., F.A.C.S., Little Rock, Arkansas; R. Gordon Douglas, M.D., New York; Edward G. Waters, M.D., F.A.C.S., Jersey City, New Jersey.

3:30—5:00 p.m.

METHODS OF DETECTING OVULATION

Moderator: Somers H. Sturgis, M.D., F.A.C.S., Boston.

Collaborators: C. Lee Buxton, M.D., New Haven, Connecticut; S. Leon Israel, M.D., F.A.C.S., Philadelphia; W. T. Pommerenke, M.D., F.A.C.S., Rochester, New York.

Wednesday, 1:30—3:00 p.m.

MANAGEMENT OF COMPLICATIONS OF LABOR CAUSING FETAL DISTRESS

Moderator: Frank E. Whitacre, M.D., F.A.C.S., Nashville, Tennessee.

Collaborators: J. Milton Singleton, M.D., F.A.C.S., Kansas City, Kansas; Franklin L. Payne, M.D., F.A.C.S., Philadelphia; Robert A. Ross, M.D., F.A.C.S., Chapel Hill, North Carolina.

3:30—5 p.m.

PROBLEMS OF STRESS INCONTINENCE

Moderator: William E. Studdiford, M.D., F.A.C.S., Bay Head, New Jersey.

Collaborators: Albert H. Aldridge, M.D., F.A.C.S., New York; Thomas L. Ball, M.D., F.A.C.S., New York; Joshua William Davies, M.D., F.A.C.S., New York; D. Anthony D'Esopo, M.D., New York; Eugene A. Edwards, M.D., F.A.C.S., Chicago.

Friday, 8:30—11:30 a.m.

SYMPOSIUM IN GYNECOLOGY AND OBSTETRICS

Moderator: Louis M. Hellman, M.D., F.A.C.S., Brooklyn.

Relationship of Endocrine to Endometriosis. Robert W. Kistner, M.D., F.A.C.S., Brookline, Massachusetts.

Surgical Treatment of Uterine Malformations. Howard W. Jones, Jr., M.D., Baltimore.

Oxygen Gradients Across the Placenta. Harry Prystowsky, M.D., Baltimore.

Fetal Heart Rate Recording. Edward H. Hon, M.D., New Haven, Connecticut.

Progress with the Cytoanalyzer. Walter Tolles, M.SC., Mineola, New York.

1:30—3:00 p.m.

MODERN MANAGEMENT OF FACE, BROW, AND TRANSVERSE PRESENTATIONS

Moderator: C. Paul Hodgkinson, M.D., F.A.C.S., Detroit.

Collaborators: Ralph E. Campbell, M.D., F.A.C.S., Madison, Wisconsin; George A. Hahn, M.D., F.A.C.S., Philadelphia; John E. Savage, M.D., F.A.C.S., Baltimore.

3:15—4:45 p.m.

ENDOMETRIOSIS

Moderator: Roger B. Scott, M.D., Cleveland.

Collaborators: Clayton T. Beecham, M.D., F.A.C.S., Philadelphia; Laman A. Gray, M.D., F.A.C.S., Louisville, Kentucky; Lowell F. Peterson, M.D., F.A.C.S., Chicago.

NEUROLOGIC SURGERY

Friday, 9:00—10:30 a.m., Trimble Hall, Claridge

DERMOID AND EPIDERMOID TUMORS OF CENTRAL NERVOUS SYSTEM (Symposium)

Moderator: EDGAR F. FINCHER, M.D., F.A.C.S., Emory University, Georgia.

Collaborators: (in Children) DONALD D. MATSON, M.D., F.A.C.S., Boston; CHARLES E. DOWMAN, M.D., F.A.C.S., Atlanta, Georgia; (in Adults) COLLIN S. MACCARTHY, M.D., F.A.C.S., Rochester, Minnesota; M. FRANK TURNEY, M.D., F.A.C.S., Knoxville, Tennessee.

10:35 a.m.—12 noon, Trimble Hall, Claridge

TRAUMATIC INTRACRANIAL HEMORRHAGE (Symposium)

Moderator: E. S. GURDJIAN, M.D., F.A.C.S., Detroit.

Collaborators: E. JEFFERSON BROWDER, M.D., F.A.C.S., Brooklyn; FRANCIS ASBURY ECHLIN, M.D., F.A.C.S., New York; JOHN RAAF, M.D., F.A.C.S., Portland, Oregon.

2:00—5:00 p.m., Trimble Hall, Claridge

CLINICAL NEUROSURGICAL SUBJECTS

RUSSEL MEYERS, M.D., F.A.C.S., Iowa City, Iowa, *Presiding*.

Massive Frontal Epidural Hematoma as a Complication of Ventricular Drainage and Ventriculography. LESTER A. MOUNT, M.D., F.A.C.S.; HAROLD HAFT, M.D.; HENRY LISS, M.D., New York. Discussion opened by DONALD MUNRO, M.D., F.A.C.S., Milton, Massachusetts.

The Tethered Spinal Cord Syndrome and Its Relation to Urinary Incontinence. IRA J. JACKSON, M.D., F.A.C.S., Galveston, Texas. Discussion opened by ROBERT A. GROFF, M.D., F.A.C.S., Philadelphia.

The Effects of Intracranial Disease on Gastric Secretion. RICHARD A. DAVIS, M.D., Chicago. Discussion opened by GEORGE PERRET, M.D., F.A.C.S., Iowa City, Iowa.

Inflammatory Intervertebral Disc Disease as a Postoperative Complication of Treatment of Herniation in the Lumbar Area. W. EUGENE STERN, M.D., F.A.C.S., Los Angeles. Discussion opened by J. LAWRENCE POOL, M.D., F.A.C.S., New York.

Problems Associated with the Diagnosis and Treatment of Carotid Artery-Cavernous Sinus Fistulas. RICHARD C. SCHNEIDER, M.D., F.A.C.S.; JOHN W. HENDERSON, M.D.; JAMES W. DYLL, M.D., Ann Arbor. Discussion opened by FLOYD H. BRAGDON, M.D., F.A.C.S., Pittsburgh.

Cranio-Orbital Lesions. FRANK P. SMITH, M.D., Rochester, New York. Discussion opened by CARLOS G. DE GUTIÉRREZ-MAHONEY, M.D., F.A.C.S., New York.

ORTHOPEDIC SURGERY

Friday, 1:30—3:00 p.m., American Room, Traymore

AMPUTATION IN THE UPPER EXTREMITY

Moderator: PHILIP D. WILSON, M.D., F.A.C.S., New York.

Collaborators: CHARLES O. BECHTOL, M.D., F.A.C.S., Los Angeles; MAURICE J. FLETCHER, COL., M.S.C., Washington, D. C.; CAMERON B. HALL, M.D., F.A.C.S., Beverly Hills, California; AUGUST W. SPITTLER, COL., M.C., U.S.A., F.A.C.S., Denver.

3:15—4:45 p.m.

LIGAMENTOUS INJURIES OF THE KNEE JOINT

Moderator: ALVIN J. INGRAM, M.D., F.A.C.S., Memphis, Tennessee.

Collaborators: ROBERT G. BRASHEAR, M.D., F.A.C.S., Knoxville, Tennessee; BRUCE J. BREWER, M.D., Milwaukee; EUGENE E. RECORD, M.D., Boston.

PLASTIC SURGERY

Monday, 1:30—3:00 p.m., Borton Hall, Dennis

SURGICAL REPAIR OF RADIATION BURNS

Moderator: FRANK MCDOWELL, M.D., F.A.C.S., St. Louis.

Collaborators: ROBIN ANDERSON, M.D., F.A.C.S., Cleveland; WILLIAM G. HAMM, M.D., F.A.C.S., Atlanta, Georgia; MICHAEL L. MASON, M.D., F.A.C.S., Chicago; HENRY P. ROYSTER, M.D., F.A.C.S., Philadelphia.

3:30—5:00 p.m., Borton Hall, Dennis

FACIAL TRAUMA FROM TRAFFIC ACCIDENTS

Moderator: L. N. CLAIBORN, M.D., F.A.C.S., New Haven, Connecticut.

Collaborators: ROBERT M. MCCORMACK, M.D., F.A.C.S., Rochester, New York; CLIFFORD C. SNYDER, M.D., F.A.C.S., Miami, Florida; FORREST YOUNG, M.D., F.A.C.S., Redlands, California.

THORACIC SURGERY

Friday, 1:30—3:00 p.m., Borton Hall, Dennis

THORACIC SURGERY IN PEDIATRICS

Moderator: CAMERON HAIGHT, M.D., F.A.C.S., Ann Arbor, Michigan.

Collaborators: C. EVERETT KOOP, M.D., F.A.C.S., Philadelphia; HUGH B. LYNN, M.D., F.A.C.S., Louisville, Kentucky; ORVAR SWENSON, M.D., F.A.C.S., Boston.

3:15—4:45 p.m., Borton Hall, Dennis

RECENT DEVELOPMENTS IN CARDIAC SURGERY

Moderator: FRANK GERBODE, M.D., F.A.C.S., San Francisco.

Collaborators: GEORGE H. A. CLOWES, JR., M.D., Cleveland; DENTON A. COOLEY, M.D., F.A.C.S., Houston, Texas; DONALD B. EFFLER, M.D., F.A.C.S., Cleveland; DENIS G. MELROSE, M.A., B.M., B.CH., London, England.

UROLOGY

Monday, 1:30—3:00 p.m., Ballroom, Ritz-Carlton

DIAGNOSIS AND MANAGEMENT OF URINARY OBSTRUCTION IN THE AGED

Moderator: WILLIAM L. VALK, M.D., F.A.C.S., Kansas City, Kansas.

Collaborators: R. G. BUNGE, M.D., F.A.C.S., Iowa City, Iowa; RICHARD CHUTE, M.D., F.A.C.S., Boston; KYRIL B. CONGER, M.D., F.A.C.S., Philadelphia.

Tuesday, 1:30—3:00 p.m., Ballroom, Ritz-Carlton

BLADDER SUBSTITUTES IN CONGENITAL AND ACQUIRED CONDITIONS

Moderator: WYLAND F. LEADBETTER, M.D., F.A.C.S., Boston.

Collaborators: A. WAITE BOHNE, M.D., Detroit; JUSTIN J. CORDONNIER, M.D., F.A.C.S., St. Louis; WILLIAM C. SHOEMAKER, M.D., Boston; SAMUEL A. VEST, M.D., F.A.C.S., Charlottesville, Virginia.

Thursday, 1:30—3:00 p.m., Ballroom, Ritz-Carlton

DIAGNOSIS AND MANAGEMENT, SURGICAL LESIONS OF THE ADRENALS

Moderator: GEORGE F. CAHILL, M.D., F.A.C.S., New York.

Collaborators: OLIVER COPE, M.D., F.A.C.S., Boston; J. HARTWELL HARRISON, M.D., F.A.C.S., Boston; JOSEPH W. JAILER, M.D., New York; WILLIAM WALLACE SCOTT, M.D., Baltimore.

Friday, 1:30—3:00 p.m., Ballroom, Ritz-Carlton

THE ABDOMINAL MASS IN CHILDREN AND ADULTS

Moderator: CHARLES C. HIGGINS, M.D., F.A.C.S., Cleveland.

Collaborators: RUBIN H. FLOCKS, M.D., F.A.C.S., Iowa City, Iowa; J. WILLIAM HINTON, M.D., F.A.C.S., New York; JOE V. MEIGS, M.D., F.A.C.S., Boston; WILLIAM THORNTON MUSTARD, M.D., F.A.C.S., Toronto.

Symposium on Trauma: The Immediate Treatment of Multiple Injuries

Tuesday, 2:00—5:00 p.m., Renaissance and Venetian Rooms, Ambassador

PRESTON A. WADE, M.D., F.A.C.S., New York, *Presiding.*

The Physician Organizes for National Survival. LIVINGSTON PARSONS, JR., M.D., Greenwich, Connecticut; FRANK B. BERRY, M.D., F.A.C.S., Washington, D. C.

The Surgical Treatment of Burns. LOUIS M. ROUSSELOT, M.D., F.A.C.S., New York.

The Treatment of Chest Trauma. MICHAEL E. DEBAKEY, M.D., F.A.C.S., Houston, Texas.

The Management of Head Injuries in the Multiple Injury Patient. EDWARD B. SCHLESINGER, M.D., New York.

Priorities for Initial Care in Disaster. JOSEPH R. SHAEFFER, COL., M.C., U.S.A., F.A.C.S., Washington, D. C.

The Treatment of Arterial Injuries. JERE W. LORD, JR., M.D., F.A.C.S., New York.

Symposium on Cancer

Wednesday, 2:45—5:00 p.m., Renaissance and Venetian Rooms, Ambassador

DANELY P. SLAUGHTER, M.D., F.A.C.S., Chicago, *Presiding.*

Current Status of Diagnosis and Surgical Treatment for Carcinoma of the Colon and Rectum. FREDERICK A. COLLER, M.D., F.A.C.S., Ann Arbor, Michigan.

Current Status of Diagnosis and Surgical Treatment for Cancer About the Head and Neck. HAYES E. MARTIN, M.D., F.A.C.S., New York.

Carcinoma of the Breast in the Young. NORMAN TREVES, M.D., F.A.C.S., New York; ARTHUR I. HOLLEB, M.D., F.A.C.S., New York.

Current Status of Diagnosis and Surgical Treatment for Cancer of the Biliary Tract and Pancreas. RICHARD B. CATTELL, M.D., F.A.C.S., Boston.

Motion Picture Symposium on Spectacular Problems in Surgery

Wednesday, 7:30—10:00 p.m., Club Room, Traymore

SERIES OF SHORT FILMS PERSONALLY NARRATED BY PARTICIPATING SURGEONS

JULIAN JOHNSON, M.D., F.A.C.S., Philadelphia, *Presiding.*

Duplication of Ileum. HUGH B. LYNN, M.D., F.A.C.S., Louisville, Kentucky.

Intestinal Obstruction in Infants. CLIFFORD D. BENSON, M.D., F.A.C.S., Detroit.

"Tire Patch" Repair of Gunshot Wound of Aorta. RUDOLF J. NOER, M.D., F.A.C.S., Louisville, Kentucky. Narrated by HUGH B. LYNN, M.D., F.A.C.S., Louisville, Kentucky.

Sacrococcygeal Chordoma. FREDERICK E. KREDEL, M.D., F.A.C.S., Charleston, South Carolina.

Trichobezoar. ROWENA SPENCER, M.D., New Orleans.

Closure of Interventricular Septal Defect with Induced Cardiac Arrest. CONRAD R. LAM, M.D., F.A.C.S., Detroit.

Perforation of Cecum in Acquired Megacolon as Complication of Poliomyelitis. EDWIN H. ELLISON, M.D., F.A.C.S., Columbus, Ohio.

Arteriovenous Fistula and Aneurysm Subclavian and Innominate Arteries. JAMES D. HARDY, M.D., F.A.C.S., Jackson, Mississippi.

Reconstruction of Bronchus with Dermal Graft. WATTS R. WEBB, M.D., F.A.C.S., Jackson, Mississippi.

Neurofibroma of Jejunum. ISIDORE COHN, JR., M.D., F.A.C.S., New Orleans.

Siamese Twins. HARWELL WILSON, M.D., F.A.C.S., Memphis, Tennessee.

Tribute to Dr. Evarts A. Graham. WARREN H. COLE, M.D., F.A.C.S., Chicago.

Myxoma of the Left Auricle Simulating Mitral Stenosis. DENTON A. COOLEY, M.D., F.A.C.S., Houston, Texas.

Leiomyosarcoma of Stomach. J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston.

Fusiform Aneurysm of Ascending and Transverse Arch of Aorta. Resection with Homograft Replacement Using Extracorporeal Circulation. MICHAEL E. DEBAKEY, M.D., F.A.C.S., Houston.

Symposium on Graduate Training in Surgery and the Surgical Specialties

Thursday, 1:30—3:00 p.m., Borton Hall, Dennis

FREDERICK A. COLLER, M.D., F.A.C.S., Ann Arbor, Michigan, *Presiding.*

Surgical Residency in the Moderate Size General Hospital. HARRY C. SALTZSTEIN, M.D., Detroit

Basic Surgical Training Prior to Specialization. Speaker to be announced.

Television

Monday, 9:00—10:15 a.m., Stage, Convention Hall

Techniques of Anesthesia. DONALD W. BENSON, M.D., Baltimore.

Moderator: WILLIS J. POTTS, M.D., F.A.C.S., Chicago.

Panel: DOUGLAS W. EASTWOOD, M.D., Charlottesville, Virginia; and ARTHUR S. KEATS, M.D., Houston, Texas.

10:30 a.m.—12 noon

Closure of Auricular Septal Defect. FRANK C. SPENCER, M.D., Baltimore.

Moderator: HENRY SWAN, M.D., F.A.C.S., Denver.

Panel: F. JOHN LEWIS, M.D., F.A.C.S., Chicago; H. WILLIAM SCOTT, JR., M.D., F.A.C.S., Nashville, Tennessee.

2:00—3:15 p.m.

Temporal Lobe Excision for Psychomotor Epilepsy. A. EARL WALKER, M.D., F.A.C.S., Baltimore.

Moderator: PAUL C. BUCY, M.D., F.A.C.S., Chicago.

Panel: JOHN RAYMOND GREEN, M.D., F.A.C.S., Phoenix, Arizona; THEODORE RASMUSSEN, M.D., Montreal.

3:30—5:00 p.m.

Pulmonary Resection. RICHARD F. KIEFFER, JR., M.D., Baltimore.
Moderator: RICHARD H. SWEET, M.D., F.A.C.S., Boston.
Panel: J. MAXWELL CHAMBERLAIN, M.D., F.A.C.S., New York; JOHN C. JONES, M.D., F.A.C.S., Los Angeles.

Tuesday, 9:00—10:15 a.m.

Systemic Pulmonary Anastomosis for Tetralogy of Fallot. ALFRED BLALOCK, M.D., F.A.C.S., Baltimore.
Moderator: FRANK GERBODE, M.D., F.A.C.S., San Francisco.
Panel: GEORGE H. HUMPHREYS, II, M.D., F.A.C.S., New York; WILLIAM H. MULLER, JR., M.D., F.A.C.S., Charlottesville, Virginia; WILLIS J. POTTS, M.D., F.A.C.S., Chicago.

10:30 a.m.—12:00 noon

Repair of Pectus Excavatum. MARK M. RAVITCH, M.D., F.A.C.S., Baltimore.
Moderator: ROBERT E. GROSS, M.D., F.A.C.S., Boston.
Panel: CHARLES W. LESTER, M.D., F.A.C.S., New York; HERBERT C. MAIER, M.D., F.A.C.S., New York.

2:00—3:15 p.m.

Thyroidectomy. EDWARD S. STAFFORD, M.D., F.A.C.S., Baltimore.
Moderator: WARREN H. COLE, M.D., F.A.C.S., Chicago.
Panel: RICHARD B. CATTELL, M.D., F.A.C.S., Boston; BROWN M. DOBYNS, M.D., F.A.C.S., Cleveland.

3:30—5:00 p.m.

Interruption of Patent Ductus. DAVID C. SABISTON, JR., M.D., Baltimore.
Moderator: K. ALVIN MERENDINO, M.D., F.A.C.S., Seattle.
Panel: THOMAS H. BURFORD, M.D., F.A.C.S., St. Louis; R. ADAMS COWLEY, M.D., Baltimore.

Wednesday, 9:00—10:15 a.m.

Gastrectomy. GEORGE G. FINNEY, M.D., F.A.C.S., Baltimore.
Moderator: FREDERICK A. COLLER, M.D., F.A.C.S., Ann Arbor, Michigan.
Panel: CLARENCE J. BERNE, M.D., F.A.C.S., Los Angeles; ALTON OCHSNER, M.D., F.A.C.S., New Orleans.

10:30 a.m.—12 noon

Repair of Ventricular Septal Defect. HENRY T. BAHNSON, M.D., F.A.C.S., Baltimore.
Moderator: JOHN H. GIBBON, JR., M.D., F.A.C.S., Philadelphia.
Panel: GEORGE H. A. CLOWES, JR., M.D., Cleveland; DENTON A. COOLEY, M.D., F.A.C.S., Houston, Texas; C. WALTON LILLEHEI, M.D., F.A.C.S., Minneapolis.

2:00—3:15 p.m.

Bladder Substitution. WILLIAM WALLACE SCOTT, M.D., Baltimore.
Moderator: EUGENE M. BRICKER, M.D., F.A.C.S., St. Louis.
Panel: R. KENNEDY GILCHRIST, M.D., F.A.C.S., Chicago; WILLARD E. GOODWIN, M.D., F.A.C.S., Los Angeles.

3:15—5:00 p.m.

Operation for Pancreatic Disease. I. RIDGEWAY TRIMBLE, M.D., F.A.C.S., Baltimore.
Moderator: JOHN H. MULHOLLAND, M.D., F.A.C.S., New York.
Panel: EDWIN H. ELLISON, M.D., F.A.C.S., Columbus, Ohio; KENNETH W. WARREN, M.D., F.A.C.S., Boston.

Thursday, 9:00—10:15 a.m.

Radical Mastectomy. WARFIELD M. FIROR, M.D., F.A.C.S., Baltimore.
Moderator: CLARENCE E. GARDNER, JR., M.D., F.A.C.S., Durham, North Carolina.
Panel: ROBERT W. BUXTON, M.D., F.A.C.S., Baltimore; CHARLES ECKERT, M.D., F.A.C.S., Albany, New York.

10:30 a.m.—12:00 noon

Spaulding-Richardson Composite Operation for Uterine Prolapse. RICHARD W. TELINDE, M.D., Baltimore.
Moderator: HOWARD ULFELDER, M.D., F.A.C.S., Boston.
Panel: VIRGIL S. COUNSELLER, M.D., F.A.C.S., Rochester, Minnesota; EUGENE A. EDWARDS, M.D., F.A.C.S., Chicago.

2:00—3:15 p.m.

Operation for Biliary Disease. JAMES P. ISAACS, M.D., Baltimore.
Moderator: I. S. RAVDIN, M.D., F.A.C.S., Philadelphia.
Panel: JOEL W. BAKER, M.D., F.A.C.S., Seattle; FRANK GLENN, M.D., F.A.C.S., New York.

Friday, 9:00—10:15 a.m.

Portacaval Shunt for Portal Hypertension. JAMES R. CANTRELL, M.D., Baltimore.
Moderator: LOUIS M. ROUSSELOT, M.D., F.A.C.S., New York.
Panel: ARTHUR H. BLAKEMORE, M.D., New York; MARY ANN PAYNE, M.D., New York.

10:30 a.m.—12:00 noon

Excision of Aortic Aneurysm. HENRY T. BAHNSON, M.D., F.A.C.S., Baltimore.
Moderator: MICHAEL E. DEBAKEY, M.D., F.A.C.S., Houston, Texas.
Panel: ORMAND C. JULIAN, M.D., F.A.C.S., Chicago; CONRAD R. LAM, M.D., F.A.C.S., Detroit.

2:00—3:15 p.m.

Goebel-Stoeckel Operation for Incontinence. RICHARD W. TELINDE, M.D., Baltimore.
Moderator: LANGDON PARSONS, M.D., F.A.C.S., Boston.
Panel: ALBERT H. ALDRIDGE, M.D., F.A.C.S., New York; JOHN H. RIDLEY, M.D., F.A.C.S., Atlanta, Georgia.

Ciné Clinics

Tuesday, 8:30 a.m.—12:30 p.m., Ballroom, Convention Hall

GROVER C. PENBERTHY, M.D., F.A.C.S., Detroit, *Presiding.*

CINÉ PANEL ON BILIARY TRACT AND PANCREAS:

The Surgical Treatment of Pancreatic Pseudo-Cysts. DAVID M. HUME, M.D., F.A.C.S., Richmond, Virginia.
Caudal Pancreatico-Jejunostomy for Chronic (Relapsing) Pancreatitis. JOHN A. SCHILLING, M.D., F.A.C.S., Oklahoma City, Oklahoma.
Choledochojejunostomy for Restoration of Biliary Drainage. CHARLES G. CHILD, III, M.D., F.A.C.S., Boston.
Cholecystectomy and Exploration of the Common Bile Duct. PROFESSOR JOHN BRUCE, Edinburgh, Scotland.
The Surgical "Acalculous" Gallbladder. JOHN M. DORSEY, M.D., F.A.C.S., Evanston, Illinois.
Common Duct Stones. ROBERT M. MOORE, M.D., F.A.C.S., Galveston, Texas.
Panel Discussion.

Wednesday, 8:30 a.m.—12:30 p.m., Ballroom, Convention Hall

ALLEN M. BOYDEN, M.D., F.A.C.S., Portland, Oregon, *Presiding.*

Surgery of the Adrenal Glands. VICTOR RICHARDS, M.D., F.A.C.S., San Francisco.
Indications and Technique of Right Hepatectomy. JOHN T. REYNOLDS, M.D., F.A.C.S., Chicago.
Surgical Treatment of Bronchogenic Carcinoma. GEORGE V. BRINDLEY, JR., M.D., F.A.C.S., Temple, Texas.
Safe and Conservative Treatment of Lesions of the Female Breast. W. EMORY BURNETT, M.D., F.A.C.S., Philadelphia.
Ciné Interviews with Surgeons of British Isles. Conducted by SIR GORDON GORDON-TAYLOR, London, England; SIR HARRY PLATT, Manchester, England; SIR WALTER MERCER, Edinburgh, Scotland; SIR HENRY SOUTTAR, London, England; SIR HAROLD D. GILLIES, London, England.
Presentation of Ciné Clinic Awards.
Emergency Surgery of the Acutely Injured. JAMES D. HARDY, M.D., F.A.C.S., Jackson, Mississippi.
The Story of Renal Calculi. CHARLES C. HIGGINS, M.D., F.A.C.S., Cleveland.

Thursday, 8:30 a.m.—12:30 p.m., Ballroom, Convention Hall

WILLIAM H. MULLER, JR., M.D., F.A.C.S., Charlottesville, Virginia, *Presiding.*

Relief of Obstruction of Superior Vena Cava by Venous Autografts. C. ROLLINS HANLON, M.D., F.A.C.S., St. Louis.
The Repair of Esophageal Hiatal Hernia Using the Abdominal Approach. JAMES H. GROWDON, M.D., F.A.C.S., Little Rock, Arkansas.
Lesions of the Fallopian Tube. NEWELL W. PHILPOTT, M.D., F.A.C.S., Montreal.
Vaginal and Abdominal Hysterectomy. JOHN ARTHUR STALLWORTHY, M.A.(OXON.), M.B., CH.B., F.A.C.S.(HON.), F.R.C.S.(ENG.), F.R.C.O.G., Oxford, England.
Surgical Treatment of Prolapse of the Rectum. WILLIAM A. ALTEMEIER, M.D., F.A.C.S., Cincinnati.
Cardiac Arrest. HENRY SWAN, M.D., F.A.C.S., Denver.
Exploration of Pancreas for Islet Cell Tumor. IAN AIRD, CH.M., M.B., CH.B., F.A.C.S.(HON.), F.R.C.S.(EDIN.), F.R.C.S.(ENG.), London, England.

Friday, 8:30 a.m.—12:30 p.m., Ballroom, Convention Hall

FRANK L. GERBODE, M.D., F.A.C.S., San Francisco, *Presiding.*

Cholecystectomy and Operative Cholangiography. JOEL W. BAKER, M.D., F.A.C.S., Seattle.
Transabdominal Adrenalectomy for Endocrine Disease. EDWIN H. ELLISON, M.D., F.A.C.S., Columbus.
Coarctation of the Aorta. EARLE B. MAHONEY, M.D., F.A.C.S., Rochester, New York.
Arteriovenous Fistulas of the Femoral and Innominate Vessels. JOHN M. HOWARD, M.D., F.A.C.S., Atlanta, Georgia.
Parotid Tumor. ROBERT W. BUXTON, M.D., F.A.C.S., Baltimore.
Neoplastic Disease. J. ELLIOTT SCARBOROUGH, JR., M.D., F.A.C.S., Emory University, Georgia.

Postgraduate Courses

PREOPERATIVE AND POSTOPERATIVE CARE

FRANCIS D. MOORE, M.D., F.A.C.S., Boston, *Chairman.*

Tuesday, 8:30—11:30 a.m., Ballroom, Ritz-Carlton

HENRY T. RANDALL, M.D., F.A.C.S., New York, *Moderator.*

The Effect of Disease on Regulatory Mechanisms of the Body Fluid. J. RUSSELL ELKINTON, M.D., Philadelphia.
Management of Early Postoperative Convalescence. JAMES D. HARDY, M.D., F.A.C.S., Jackson, Mississippi.
Management of Late Postoperative Convalescence; Problems in Nutrition, Oral and Intravenous. WILLIAM E. ABBOTT, M.D., F.A.C.S., Cleveland.
Nutrition and Resistance to Infection. HENRY H. BALCH, M.D., F.A.C.S., Washington, D. C.
Symposium on Surgical Fluid Problems in Infants and Young Children:
Fluid Requirements and Preoperative Procedures in Pediatric Surgery. WILLIAM B. KIESEWETTER, M.D., F.A.C.S., Pittsburgh.
Techniques and Dangers of Fluid and Blood Replacement in Infants and Young Children. ELTON WATKINS, JR., M.D., F.A.C.S., Boston.
Modification of Early Burn Treatment for Children of Various Ages and Sizes. BOYD W. HAYNES, JR., M.D., F.A.C.S., Richmond.

Wednesday, 8:30—11:30 a.m., Ballroom, Ritz-Carlton

PROBLEMS IN ACUTE TRAUMA

CHAMP LYONS, M.D., F.A.C.S., Birmingham, Alabama, *Moderator.*

Tracheotomy; Indications and Management. JEROME GIUSEFFI, JR., M.D., Cincinnati.
Transfusions; Rate, Route, and Hazards. WILLIAM S. BLAKEMORE, M.D., F.A.C.S., Philadelphia.
Hemorrhagic States Following Trauma and Massive Transfusion; Fibrinogen-Fibrinolysis Phenomenon. PAUL E. HODGSON, M.D., F.A.C.S., Ann Arbor, Michigan.
Recognition and Treatment of Invasive Sepsis After Trauma; the Use of Antibiotics in Severe Injury. CHAMP LYONS, M.D., F.A.C.S., Birmingham, Alabama.
Case Analysis Clinic:
FRANCIS D. MOORE, M.D., F.A.C.S., Boston, *Presiding.* HENRY T. RANDALL, M.D., F.A.C.S., New York; WILLIAM E. ABBOTT, M.D., F.A.C.S., Cleveland; ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus; FRASER N. GURD, M.D., F.A.C.S., Montreal; DAVID V. HABIF, M.D., F.A.C.S., New York; WALTER G. MADDOCK, M.D., F.A.C.S., Chicago.

Thursday, 8:30—11:30 a.m., Ballroom, Ritz-Carlton

SURGICAL PROBLEMS IN LIVER DISEASE

JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia, *Moderator.*

The Significant Biochemical Abnormalities in Surgical Diseases of the Liver and Portal Circulation. WILLIAM V. MCDERMOTT, JR., M.D., F.A.C.S., Boston.
Acid-Base Balance; Ammonia and Coma. HENRY T. RANDALL, M.D., F.A.C.S., New York.
Respiratory Problems and Inhalation Therapy:
Aerosol and Nebulization in Pulmonary Problems; Experiences in a Fog Room. ROE E. WELLS, JR., M.D., Boston.
The Management of the Patient with Chronic Respiratory Acidosis Before and After Surgery. ROBERT L. MAYOCK, M.D., Philadelphia.
Preoperative and Postoperative Patients Undergoing Aortic and Major Vessel Replacement Surgery. PROFESSOR CHARLES G. ROB, London, England.
Function of Stomach Remnants and Small Intestine Following Gastric Procedures. WILLIAM E. ABBOTT, M.D., F.A.C.S., Cleveland.
Studies in the Hormonal Regulation of Electrolyte Excretion After Trauma. J. G. LLAURADO, M.D., Dunedin, New Zealand.

Friday, 8:30—11:30 a.m., Ballroom, Ritz-Carlton

SYMPOSIUM ON BURNS

ROBERT E. L. BERRY, M.D., F.A.C.S., Ann Arbor, Michigan, *Moderator.*

A Burn Budget for Early Fluid Management. FRANCIS D. MOORE, M.D., F.A.C.S., Boston.

The Use of Cadaver Homografts. BRUCE G. MACMILLAN, M.D., Cincinnati.

Closure of the Late Wound. TRUMAN G. BLOCKER, JR., M.D., F.A.C.S., Galveston, Texas.

Invasive Sepsis in Burns; Recognition, Bacteriology, Antibiotics, and Management. CURTIS P. ARTZ, M.D., F.A.C.S., Jackson, Mississippi.

Case Analysis Clinic:

HENRY T. RANDALL, M.D., F.A.C.S., New York, *Presiding.* ROBERT E. L. BERRY, M.D., F.A.C.S., Ann Arbor; HORACE J. MCCORKLE, M.D., F.A.C.S., San Francisco; JOHN H. MULHOLLAND, M.D., F.A.C.S., New York; FRANCIS D. MOORE, M.D., F.A.C.S., Boston; JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia; CARL A. MOYER, M.D., F.A.C.S., St. Louis.

GASTROINTESTINAL DISEASE

S. W. MOORE, M.D., F.A.C.S., New York, *Chairman.*

Tuesday, 8:30—11:30 a.m., Borton Hall, Dennis

ESOPHAGUS

WILLIAM A. BARNES, M.D., New York, *Moderator.*

Carcinoma:

Results of Surgical Treatment. RICHARD H. SWEET, M.D., F.A.C.S., Boston.

Reconstruction After Surgical Excision. WILLIAM L. WATSON, M.D., F.A.C.S., New York.

Diaphragmatic Hernias. HOWARD H. BRADSHAW, M.D., F.A.C.S., Winston-Salem, North Carolina.

Diverticulum of the Esophagus. KENNETH W. WARREN, M.D., F.A.C.S., Boston.

Question and Answer Period

Cardiospasm and Peptic Esophagitis. Panel Discussion.

Cardiospasm. PAUL NEMIR, JR., M.D., F.A.C.S., Philadelphia. Conservative Management of Cardiospasm and Short Esophagus Type Hiatal Hernia. PORTER P. VINSON, M.D., F.A.C.P., Richmond, Virginia; Experiences with Interposed Jejunal Segment in Treatment of Peptic Esophagitis and Related Conditions. K. ALVIN MERENDINO, M.D., F.A.C.S., Seattle; Surgical Management of Cardiospasm and Peptic Esophagitis. OWEN H. WANGENSTEEN, M.D., F.A.C.S., Minneapolis.

Wednesday, 8:30—11:30 a.m., Borton Hall, Dennis

STOMACH

JOHN M. BEAL, M.D., F.A.C.S., New York, *Moderator.*

Surgical Treatment of Peptic Ulcer. Panel Discussion.

Observations on Vagotomy, Hemigastrectomy, and Billroth I Anastomosis. ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus, Ohio. Comparison of Billroth I and II Operations. J. WILLIAM HINTON, M.D., F.A.C.S., New York; Vagotomy and Gastroenterostomy for Peptic Ulcer. EDWARD R. WOODWARD, M.D., F.A.C.S., Los Angeles; Results of Treatment of Peptic Ulcer. WALTMAN WALTERS, M.D., F.A.C.S., Rochester, Minnesota.

Difficulties in Diagnosis of Malignant Lesions of Stomach. SAMUEL F. MARSHALL, M.D., F.A.C.S., Boston.

Treatment of Sarcoma. JOHN M. BEAL, M.D., F.A.C.S., New York.

Massive Bleeding from Stomach. J. ENGLEBERT DUNPHY, M.D., F.A.C.S., Boston.

Question and Answer Period

Thursday, 8:30—11:30 a.m., Borton Hall, Dennis

COLON AND RECTUM

CLARENCE DENNIS, M.D., F.A.C.S., Brooklyn, *Moderator.*

Diverticulitis. CLAUDE E. WELCH, M.D., F.A.C.S., Boston.

Ulcerative Colitis from the Medical Standpoint. MARVIN H. SLEISENGER, M.D., New York.

Vagotomy for Ulcerative Colitis. KARL E. KARLSON, M.D., Brooklyn.

Ulcerative Colitis. CLARENCE DENNIS, M.D., F.A.C.S., Brooklyn.

Question and Answer Period

Polyps of Colon and Rectum. IRVING F. ENQUIST, M.D., Brooklyn.

Carcinoma of Colon:

Prevention of Cellular Dissemination in Cancer of the Colon. WARREN H. COLE, M.D., F.A.C.S., Chicago.

Resections in the Presence of Concurrent Intra-abdominal Diseases. R. KENNEDY GILCHRIST, M.D., F.A.C.S., Chicago.

Friday, 8:30—11:30 a.m., Borton Hall, Dennis

SURGICAL CONDITIONS OF CHILDREN

C. EVERETT KOOP, M.D., F.A.C.S., Philadelphia, *Moderator.*

Preoperative and Postoperative Care of Children. H. WILLIAM CLATWORTHY, JR., M.D., F.A.C.S., Columbus, Ohio.

Congenital Hypertrophic Pyloric Stenosis. EDWARD J. DONOVAN, M.D., F.A.C.S., New York.

Appendicitis in Children. SAMUEL R. SCHUSTER, M.D., Boston.

Question and Answer Period

Hirschsprung's Disease. ORVAR SWENSON, M.D., F.A.C.S., Boston.

Intussusception. WILLIAM B. KIESEWETTER, M.D., F.A.C.S., Pittsburgh.

Intestinal Atresia. C. EVERETT KOOP, M.D., F.A.C.S., Philadelphia.

DISEASES OF THE LIVER, BILIARY TRACT, AND PANCREAS

HERBERT R. HAWTHORNE, M.D., F.A.C.S., Philadelphia, *Chairman.*

Tuesday, 8:30—11:30 a.m., Venetian Room, The Ambassador

HERBERT R. HAWTHORNE, M.D., F.A.C.S., Philadelphia, *Moderator.*

The Preparation and Timing of Operation in the Jaundiced Patient. JAMES L. ROTH, M.D., Philadelphia.

The Acute Gallbladder; Methods of Management and Its Complications. WILLIAM T. FITTS, JR., M.D., F.A.C.S., Philadelphia.

Strictures of the Common Duct; Methods of Reconstruction. ARTHUR W. ALLEN, M.D., F.A.C.S., Boston.

Methods for Determining the Necessity of Duct Exploration; Preoperative and Operative. HERBERT R. HAWTHORNE, M.D., F.A.C.S., Philadelphia.

Indications and Methods for Hepatic Resection. JOHN T. REYNOLDS, M.D., F.A.C.S., Chicago.

Wednesday, 8:30—11:30 a.m., Venetian Room, The Ambassador

PANCREAS

JONATHAN E. RHOADS, M.D., F.A.C.S., Philadelphia, *Moderator.*

Experimental Aspects of Pancreatitis. JOHN A. GIUS, M.D., F.A.C.S., Iowa City, Iowa.

Clinical Aspects of Pancreatitis. ALFRED S. FROBESE, M.D., F.A.C.S., Philadelphia.

Clinical Experiences with Pancreatitis. JOHN R. PAXTON, M.D., F.A.C.S., Glendale, California.

Benign Tumors. JOHN M. HOWARD, M.D., F.A.C.S., Atlanta, Georgia.

Malignant Tumors. HAROLD A. ZINTEL, M.D., F.A.C.S., New York.

Thursday, 8:30—11:30 a.m., Venetian Room, The Ambassador

ESOPHAGUS AND CARDIOESOPHAGEAL AREA

J. WILLIAM HINTON, M.D., F.A.C.S., New York, *Moderator.*

Abnormal Variants in Physiology of the Cardioesophageal Junction. JAMES L. D'A. ROTH, M.D., Philadelphia.

Esophagitis. K. ALVIN MERENDINO, M.D., F.A.C.S., Seattle.

Hiatal Hernia. CHARLES K. KIRBY, M.D., F.A.C.S., Philadelphia.

Achalasia; Present Status of Surgical Management. PAUL NEMIR, JR., M.D., F.A.C.S., Philadelphia.

Ulcer on the Adjacent Side of the Cardioesophageal Junction; Methods of Surgical Management. J. WILLIAM HINTON, M.D., F.A.C.S., New York.

Friday, 8:30—11:30 a.m., Venetian Room, The Ambassador

SPLEEN, LIVER, AND PANCREAS

ROBERT M. ZOLLINGER, M.D., F.A.C.S., Columbus, Ohio, *Moderator.*

Hypersplenism. ROGER D. WILLIAMS, M.D., F.A.C.S., Columbus, Ohio.

Splenectomy; Indications, Technique, Complications. ADOLPH A. WALKLING, M.D., F.A.C.S., Philadelphia.

The Physiopathology in Cirrhosis of Liver. HAROLD G. BARKER, M.D., F.A.C.S., New York.

Emergency Treatment of Bleeding Esophageal Varices and Late Results of Portocaval Shunts. C. STUART WELCH, M.D., F.A.C.S., Albany, New York.

Neurectomy of the Head of the Pancreas for the Relief of Pain Due to Chronic Pancreatitis; a New Technical Procedure and Its Results. A Motion Picture Film by Hajima Yoshioka, M.D., Tokyo, to be presented by WALTMAN WALTERS, M.D., F.A.C.S., Rochester, Minnesota.

CARDIOVASCULAR SURGERY

H. WILLIAM SCOTT, JR., M.D., F.A.C.S., Nashville, *Chairman.*

Tuesday, 8:30—11:30 a.m., Wedgwood Room, Marlborough-Blenheim

H. WILLIAM SCOTT, JR., M.D., F.A.C.S., Nashville, Tennessee, *Moderator.*

Problems in Thromboembolism. GEZA DE TAKATS, M.D., F.A.C.S., Chicago.

Postphlebitic Venous Stasis and Ulceration. RICHARD WARREN, M.D., F.A.C.S., Boston.

Arterial Injuries. FIORINDO A. SIMEONE, M.D., F.A.C.S., Cleveland.

Arterial Embolism. ROBERT R. LINTON, M.D., F.A.C.S., Boston.

Arteriovenous Fistulas. FRANK GERBODE, M.D., F.A.C.S., San Francisco.

Panel: Portal Hypertension and Bleeding Esophageal Varices.

Moderator: ARTHUR H. BLAKEMORE, M.D., New York.

Collaborators: DAVID V. HABIF, M.D., F.A.C.S., New York; J. GARROTT ALLEN, M.D., F.A.C.S., Chicago; ROBERT R. LINTON, M.D., F.A.C.S., Boston; GEORGE CRILE, JR., M.D., F.A.C.S., Cleveland.

Wednesday, 8:30—11:30 a.m.

C. ROLLINS HANLON, M.D., F.A.C.S., St. Louis, *Moderator.*

Aorto-Iliac Occlusive Disorders. OSCAR CREECH, JR., M.D., F.A.C.S., New Orleans.

Atherosclerotic Occlusive Disorders of the Peripheral Arteries. WILEY F. BARKER, M.D., F.A.C.S., Los Angeles.

Aneurysms of the Thoracic Aorta. DENTON A. COOLEY, M.D., F.A.C.S., Houston, Texas.

Aneurysms of the Abdominal Aorta and Peripheral Arteries. HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis.

Panel: Arterial Aneurysms, Occlusions, and Grafts.

Moderator: MICHAEL E. DEBAKEY, M.D., F.A.C.S., Houston, Texas.

Collaborators: ORMAND C. JULIAN, M.D., F.A.C.S., Chicago; EDWIN J. WYLIE, M.D., F.A.C.S., San Francisco; CHARLES G. ROB, F.R.C.S. (E), London, England; HARRIS B. SHUMACKER, JR., M.D., F.A.C.S., Indianapolis.

Thursday, 8:30—11:30 a.m.

H. WILLIAM SCOTT, JR., M.D., F.A.C.S., Nashville, Tennessee, *Moderator.*

Patent Ductus; Typical and Atypical. GEORGE H. HUMPHREYS, II, M.D., F.A.C.S., New York.

Tetralogy of Fallot and Allied Disorders. HENRY T. BAHNSON, M.D., F.A.C.S., Baltimore.

Congenital Stenoses of Pulmonic and Aortic Valves. HENRY SWAN, M.D., F.A.C.S., Denver.

Atrial Septal Defects. ROBERT E. GROSS, M.D., F.A.C.S., Boston.

Panel: Open Heart Surgery.

Moderator: C. WALTON LILLEHEI, M.D., F.A.C.S., Minneapolis.

Collaborators: DWIGHT C. MCGOON, M.D., Rochester, Minnesota; DENTON A. COOLEY, M.D., F.A.C.S., Houston, Texas; CONRAD R. LAM, M.D., F.A.C.S., Detroit; DONALD B. EFFLER, M.D., F.A.C.S., Cleveland.

Friday, 8:30—11:30 a.m.

JOHN H. GIBBON, JR., M.D., F.A.C.S., Philadelphia, *Moderator.*

Mitral Stenosis. ROLLIN A. DANIEL, JR., M.D., F.A.C.S., Nashville, Tennessee.

Mitral Insufficiency. JULIO C. DAVILA, M.D., Media, Pennsylvania.

Aortic Stenosis. WILLIAM H. MULLER, JR., M.D., F.A.C.S., Charlottesville, Virginia.

Aortic Insufficiency. CHARLES A. HUFNAGEL, M.D., F.A.C.S., Washington, D. C.

Panel: Coronary Artery Disease.

Moderator: ALFRED BLALOCK, M.D., F.A.C.S., Baltimore.

Collaborators: ROBERT P. GLOVER, M.D., F.A.C.S., Philadelphia; ARTHUR VINEBERG, M.D., F.A.C.S., Montreal; JACK A. CANNON, M.D., F.A.C.S., Los Angeles; BERNARD L. BROFMAN, M.D., Cleveland.

IMMEDIATE TREATMENT OF MULTIPLE INJURIES

PRESTON A. WADE, M.D., F.A.C.S., New York, *Chairman.*

Tuesday, 8:30—11:30 a.m., Room 20, Convention Hall

THE IMMEDIATE TREATMENT OF MULTIPLE INJURIES

OSCAR P. HAMPTON, JR., M.D., F.A.C.S., St. Louis, *Moderator.*

First-Aid and Transportation (Emergency Medical Care). DOUGLAS LINDSEY, LT. COL., M.C., U.S.A., F.A.C.S., Washington, D. C.

Accident Room Care. JAMES C. DRYE, M.D., F.A.C.S., Louisville, Kentucky.

Open Wounds and Open Fractures. ROBERT P. KELLY, M.D., F.A.C.S., Emory University, Georgia.

Priorities for Initial Care in Disaster. JOSEPH R. SHAEFFER, COL., M.C., U.S.A., F.A.C.S., Washington, D. C.

Wednesday, 8:30—11:30 a.m.

FRANK H. MAYFIELD, M.D., F.A.C.S., Cincinnati, *Moderator.*

Head Injuries. EBEN ALEXANDER, JR., M.D., F.A.C.S., Winston-Salem, North Carolina.
Facial Injuries. TRUMAN G. BLOCKER, JR., M.D., F.A.C.S., Galveston, Texas.
Hand Injuries. MICHAEL L. MASON, M.D., F.A.C.S., Chicago.
Spinal Cord Injuries. DONALD D. MATSON, M.D., F.A.C.S., Boston.

Thursday, 8:30—11:30 a.m.

MULTIPLE INJURIES TO THE MOTOR-SKELETAL SYSTEM

HARRISON L. MCLAUGHLIN, M.D., F.A.C.S., New York, *Moderator.*

Injuries of the Upper Extremities. FREDERICK M. SMITH, M.D., F.A.C.S., New York.
Lower Extremities. GEORGE J. CURRY, M.D., F.A.C.S., Flint, Michigan.
Multiple Injuries of the Trunk. JESSE W. MAHONEY, M.D., F.A.C.S., New York.
Multiple Injuries of the Soft Tissues. THOMAS B. QUIGLEY, M.D., F.A.C.S., Boston.

Friday, 8:30—11:30 a.m.

MULTIPLE INJURIES INVOLVING THE ABDOMEN AND CHEST

HAROLD A. ZINTEL, M.D., F.A.C.S., New York, *Moderator.*

Injuries to Chest. ROBERT P. GLOVER, M.D., F.A.C.S., Philadelphia.
Injuries to Abdomen. WILLIAM T. FITTS, JR., M.D., F.A.C.S., Philadelphia.
Treatment of Shock and Hemorrhage. JOHN M. HOWARD, M.D., F.A.C.S., Atlanta, Georgia.
Injuries to Kidney and Bladder. VICTOR F. MARSHALL, M.D., F.A.C.S., New York.

GYNECOLOGY AND OBSTETRICS

LOUIS M. HELLMAN, M.D., F.A.C.S., Brooklyn, *Chairman.*

Monday, 8:30—11:30 a.m., Ballroom, The Shelburne

PERINATAL LOSS

LOUIS M. HELLMAN, M.D., F.A.C.S., Brooklyn, *Moderator.*

Anesthesia, Analgesia, and Resuscitation. VIRGINIA APGAR, M.D., New York.
Factors in the Genesis of Cerebral Palsy and Mental Deficiency. GLIDDEN L. BROOKS, M.D., New York.
Factors in the Preventability of Perinatal Loss. SCHUYLER G. KOHL, M.D., Brooklyn.

Tuesday, 8:30—11:30 a.m.

DYSTOCIA

BERNARD J. PISANI, M.D., F.A.C.S., New York, *Moderator.*

Malpresentation. WILLIS E. BROWN, M.D., F.A.C.S., Little Rock, Arkansas.
Pelvic Contraction. CHARLES M. STEER, M.D., F.A.C.S., New York.
Uterine Dysfunction. LOUIS M. HELLMAN, M.D., F.A.C.S., Brooklyn.

Wednesday, 8:30—11:30 a.m.

ENDOCRINOLOGY

J. EDWARD HALL, M.D., F.A.C.S., Brooklyn, *Moderator.*

Aberrations of Menstruation. GEORGEANNA E. SEEGAR JONES, M.D., Baltimore.
Ovarian Dysgenesis. ROBERT GREENBLATT, M.D., Augusta, Georgia.
Endocrinologic Aspects of Genital Cancer. GRAY H. TWOMBLY, M.D., New York.

Thursday, 8:30—11:30 a.m.

GENITAL CARCINOMA

JOE V. MEIGS, M.D., F.A.C.S., Boston, *Moderator.*

Endometrial Carcinoma. S. B. GUSBERG, M.D., F.A.C.S., New York.
Cervical Carcinoma. JOHN C. MASTERSON, M.D., F.A.C.S., Brooklyn.
Ovarian Carcinoma. HOWARD C. TAYLOR, JR., M.D., F.A.C.S., New York.
Vulvar Carcinoma. FRANK G. NIX, M.D., F.A.C.S., New Orleans.

Friday, 8:30—11:30 a.m.

OPEN DAY

LOUIS M. HELLMAN, M.D., F.A.C.S., Brooklyn, *Moderator.*

Relationship of Endocrines to Endometriosis. ROBERT W. KISTNER, M.D., F.A.C.S., Boston.
Surgical Treatment of Uterine Malformations. HOWARD W. JONES, JR., M.D., Baltimore.
Oxygen Gradients Across the Placenta. HARRY PRYSTOWSKY, M.D., Baltimore.
Fetal Heart Rate Recording. EDWARD H. G. HON, M.D., New Haven, Connecticut.
Progress with the Cytoanalyzer. WALTER TOLLES, M.SC., Mineola, New York.

FRACTURES IN CHILDREN AND IN THE AGED

EDWIN F. CAVE, M.D., F.A.C.S., Boston, *Chairman.*

Tuesday, 8:30—11:30 a.m., St. Denis Room, Dennis

LOWER EXTREMITY—FRACTURES IN CHILDREN

Introduction. EDWIN F. CAVE, M.D., F.A.C.S., Boston.

Principles and Prognosis in Fracture Management. WALTER P. BLOUNT, M.D., F.A.C.S., Milwaukee.

Femoral Shaft Fractures. JESSE T. NICHOLSON, M.D., F.A.C.S., Philadelphia.

Upper Femoral Fractures (Including Epiphyseal Injuries). ALVIN J. INGRAM, M.D., F.A.C.S., Memphis, Tennessee.

Fractures About the Knee. FRANCIS E. WEST, M.D., F.A.C.S., San Diego, California.

Fractures of the Tibia and Fibula. DAVID S. GRICE, M.D., Boston.

Fractures of the Ankle. WALTER P. BLOUNT, M.D., F.A.C.S., Milwaukee.

Questions and Answers. DRS. CAVE and BLOUNT and Panel.

Wednesday, 8:30—11:30 a.m.

UPPER EXTREMITY—FRACTURES IN CHILDREN

Introduction. EDWIN F. CAVE, M.D., F.A.C.S., Boston.

Forearm Fractures. WALTER P. BLOUNT, M.D., F.A.C.S., Milwaukee.

Fractures of the Elbow (Including Condyles and Radial Neck). FREDERICK M. SMITH, M.D., F.A.C.S., New York.

Supracondylar Fractures of the Humerus-Volkmann's Contracture. BARBARA B. STIMSON, M.D., F.A.C.S., Poughkeepsie, New York.

Fractures of the Shoulder and Humeral Shaft. BRUCE J. BREWER, M.D., Milwaukee.

Epiphyseal Injuries. ALEXANDER P. AITKEN, M.D., F.A.C.S., Brookline, Massachusetts.

Pathologic Fractures. HAROLD A. SOFIELD, M.D., F.A.C.S., Oak Park, Illinois.

Questions and Answers. DRS. CAVE and BLOUNT and Panel.

Thursday, 8:30—11:30 a.m.

FRACTURES IN AGED

Introduction. EDWIN F. CAVE, M.D., F.A.C.S., Boston.

The Aging Process in Bone. PHILIP H. HENNEMAN, M.D., Boston.

General Principles of Fracture Management in the Aged. EDGAR M. BICK, M.D., F.A.C.S., New York.

Fractures of the Spine. CARTER R. ROWE, M.D., F.A.C.S., Boston.

Fractures of the Forearm and Wrist. JAMES E. BATEMAN, M.D., F.R.C.S. (c), Toronto.

Fractures of the Shoulder, Humerus, and Elbow. CARTER R. ROWE, M.D., F.A.C.S., Boston.

Pathologic Fractures. WILBERT H. MCGAW, M.D., F.A.C.S., Cleveland.

Questions and Answers. DRS. CAVE and ROWE and Panel.

Friday, 8:30—11:30 a.m.

FRACTURES IN AGED

Introduction. EDWIN F. CAVE, M.D., F.A.C.S., Boston.

Fractures of the Hip. OTTO E. AUFRANC, M.D., F.A.C.S., Boston; HENRY B. CRAWFORD, M.D., New York.

Fractures of the Femoral Shaft. PRESTON A. WADE, M.D., F.A.C.S., New York.

Fractures Involving the Knee Joint. DON H. O'DONOGHUE, M.D., F.A.C.S., Oklahoma City, Oklahoma.

Fractures of the Tibia, Fibula, and Ankle. CARLO S. SCUDERI, M.D., F.A.C.S., Chicago.

Questions and Answers. DRS. CAVE and ROWE and Panel.

SURGICAL ASPECTS OF PULMONARY DISEASE

JOHN W. STRIEDER, M.D., F.A.C.S., Brookline, Massachusetts, *Chairman.*

Monday, 1:30—4:30 p.m., Room 20, Convention Hall

THE FUNDAMENTAL ASPECTS OF PULMONARY SURGERY

EDWARD D. CHURCHILL, M.D., F.A.C.S., Boston, *Presiding.*

Surgical Anatomy of the Lungs and Bronchi; Including the Common Significant Anomalies. J. GORDON SCANNELL, M.D., F.A.C.S., Boston.

Thoracic Physiology; Evaluation and Clinical Application. EDWARD A. GAENSLER, M.D., F.A.C.S., Newton Centre, Massachusetts.

Surgical Diagnostic Procedures for Pulmonary Disease; Use and Misuse. HERBERT C. MAIER, M.D., F.A.C.S., New York.

The Thoracic Roentgenogram as a Surgical Tool. HIRAM LANGSTON, M.D., F.A.C.S., Chicago.

Ideal Anaesthesia for Pulmonary Surgery. HENRY K. BEECHER, M.D., Boston.

Question Period

Recess

CURRENT CONCEPTS IN THE MANAGEMENT OF THORACIC TRAUMA

The Abnormal Physiology of Thoracic Trauma. EDWARD A. GAENSLER, M.D., F.A.C.S., Newton Centre, Massachusetts.

The Immediate Management of Thoracic Trauma. WILLIAM M. TUTTLE, M.D., F.A.C.S., Detroit.

The Late Aspects of Thoracic Trauma. THOMAS H. BURFORD, M.D., F.A.C.S., St. Louis.

Summary and Remarks. EDWARD D. CHURCHILL, M.D., F.A.C.S., Boston.

Question Period

Tuesday, 1:30—4:30 p.m.

JULIAN JOHNSON, M.D., F.A.C.S., Philadelphia, *Presiding.*

Congenital Pulmonary Lesions of Surgical Significance. CAMERON HAIGHT, M.D., F.A.C.S., Ann Arbor, Michigan.

Spontaneous Pneumothorax; Management and Results. JOSEPH P. LYNCH, M.D., Brookline, Massachusetts.

Pulmonary Cysts and Emphysema; Surgical Aspects. MAX G. CARTER, M.D., New Haven, Connecticut.

Surgery of the Trachea and Bronchi. DONALD L. PAULSON, M.D., F.A.C.S., Dallas.

The Superior Vena Caval Syndrome; Significance and Treatment. J. GORDON SCANNELL, M.D., F.A.C.S., Boston.

Question Period

Recess

THORACIC INFECTIONS

The Antibacterial Therapy of Nontuberculous Pulmonary Infections Before, During, and After Thoracic Operations. CHESTER W. HOWE, M.D., F.A.C.S., Boston.

Management of Empyema Thoracis in Infants and Adults. GUSTAF E. LINDSKOG, M.D., F.A.C.S., New Haven.

The Surgery of Suppurative Pulmonary Disease and Its Complications. DAVID P. BOYD, M.D., F.A.C.S., Boston.

Surgical Aspects of Pulmonary Fungous Infections. PAUL F. WARE, M.D., F.A.C.S., Worcester, Massachusetts.

Question Period.

Wednesday, 1:30—4:30 p.m.

SURGERY OF THORACIC NEOPLASMS

JOHN H. GIBBON, JR., M.D., F.A.C.S., Philadelphia, *Presiding.*

Tumors of the Trachea and Bronchi. LAMAR SOUTTER, M.D., F.A.C.S., Boston.

Tumors of the Thoracic Cage, Pleura, and Diaphragm. GEORGE N. J. SOMMER, JR., M.D., F.A.C.S., Trenton, New Jersey.

Mediastinal Tumors. ROBERT P. GLOVER, M.D., F.A.C.S., Philadelphia.

"Solitary Circumscribed" Pulmonary Lesions, Including Neoplastic Metastatic Lesions. O. THERON CLAGETT, M.D., F.A.C.S., Rochester, Minnesota.

Question Period

Recess

BRONCHOGENIC CARCINOMA

Etiologic Factors of Significance. ERNEST L. WYNDER, M.D., New York.

Response of the Tracheobronchial Mucosa to Irritants. OSCAR AUERBACH, M.D., East Orange, New Jersey.

Radical Pneumonectomy for Bronchogenic Carcinoma. JOHN L. POOL, M.D., F.A.C.S., New York.

Lobectomy for Bronchogenic Carcinoma. JOHN C. JONES, M.D., F.A.C.S., Los Angeles.

Management of the Inoperable and Nonresectable Patient. JOSEPH P. LYNCH, M.D., Brookline, Massachusetts.

Contraindications to the Surgical Treatment of Bronchogenic Carcinoma and Summary. JOHN H. GIBBON, JR., M.D., F.A.C.S., Philadelphia.

Question Period.

Thursday, 1:30—4:30 p.m.

JOHN W. STRIEDER, M.D., F.A.C.S., Brookline, Massachusetts, *Presiding.*

SURGERY OF PULMONARY TUBERCULOSIS

Current Concepts of Chemotherapy for Pulmonary Tuberculosis. THEODORE L. BADGER, M.D., F.A.C.P., Boston.

Extrapleural Thoracoplasty; Modern Aspects. JOHN W. STRIEDER, M.D., F.A.C.S., Brookline, Massachusetts.

Extrapleural Pneumothorax and Subcostal Plombage; Indications, Technique, and Results. EDWARD A. GAENSLER, M.D., F.A.C.S., Newton Centre, Massachusetts.

Management of Tuberculous Empyema. W. WARRINER WOODRUFF, M.D., F.A.C.S., Saranac Lake, New York.

Question Period

Recess

Pulmonary Segmental Resection for Tuberculosis. J. MAXWELL CHAMBERLAIN, M.D., F.A.C.S., New York.

Lobectomy and Pneumonectomy for Tuberculosis. JOHN C. JONES, M.D., F.A.C.S., Los Angeles.

Management of Residual Space and Related Complications Following Resection for Pulmonary Tuberculosis. DANIEL A. MULVIHILL, M.D., F.A.C.S., New York.

Question Period.

Forum on Fundamental Surgical Problems

Monday, 8:30 a.m.–12:00 noon, Convention Hall, Room B.

BURNS, RADIATION, AND SURGICAL ENDOCRINOLOGY

The Effect of Skin Pigmentation on Flash Burns in Human Volunteers. JAMES W. BROOKS, FREDERICK H. SMITH, RAY C. WILLIAMS, and WILLIAM T. HAMM, JR., Richmond, Virginia.

An Assessment of Changes in Physiologic Response After Primary Immediate Excision in Burns. RICHARD DOYLE and CURTIS P. ARTZ, Jackson, Mississippi.

The Response of Mast Cells to Experimental Stimuli. J. LEONEL VILLAVICENCIO and GEZA DETAKATS, Chicago.

Intracellular and Extracellular Shifts of Water and Electrolytes During the Acute Radiation Syndrome. M. DON TURNER, ROBERT D. SLOAN, JAMES C. GRIFFIN, JR., and TOM D. NORMAN, Jackson, Mississippi.

Factors Affecting the Distribution and Retention of Radioactive Strontium. D. P. GOEL, S. C. SKORYNA, L. YAFFE, and D. R. WEBSTER, Montreal.

The Survival of Transfused Marrow in the X-irradiated Rabbit, as Indicated by Sex-Differentiated Leucocytes. K. A. PORTER and JOSEPH E. MURRAY, Boston.

Further Studies of Human Adrenal Vein Blood; Secretion of Estrogens and 17-Ketosteroids. JAMES D. HARDY and VIRGINIA B. WARD, Jackson, Mississippi.

Steroid Metabolism in Infants; Effect of Surgery on Plasma 17-21 Hydroxycorticosteroid Levels. JESSE L. WOFFORD, JAMES D. HARDY, and M. DON TURNER, Jackson, Mississippi.

The Secretion of Epinephrine, Norepinephrine, and Corticosteroids in the Adrenal Venous Blood of the Dog Following Single and Repeated Trauma. DAVID M. HUME, Richmond, Virginia.

Endocrine Factors in the Altered Blood Coagulation Potential Following Surgical Stress. JOHN A. WILLIAMS and RICHARD WARREN, Boston.

Modifications of Lean Tissue Change with Anabolic Hormone Administration. HELENA GILDER, G. N. CORNELL, W. L. CRAVER, G. JOHNSON, JR., and JOHN M. BEAL, New York.

The Effect of Trauma on Adrenal Steroid Metabolism in the Adrenalectomized Dog. RALPH M. CHRISTENSEN, WILLIAM C. SHOEMAKER, and FRANCIS D. MOORE, Boston.

Monday, 8:30 a.m.–12:00 noon, Convention Hall, Room C.

HEART AND GREAT VESSELS

Central Venous Pressures During Total Cardiac Bypass. BERNARD S. LEVOWITZ, MARIE KERNAN, RICHARD MONSES, and CLARENCE DENNIS, New York.

Right Heart Pressure Studies After Ventriculotomy. JAMES RAMS, HOWARD BRESLER, JOSEPH KISER, WILLIAM KISKEN, JAY WAGNER, and PETER V. MOULDER, Chicago.

Late Effects of Pulmonary Valve Cusp Resection in the Dog; a 5 Year Follow-up. HERMAN J. SUGARMAN, J. H. FISHER, and OLIVER L. BOWENS, JR., Boston.

Cardiopulmonary Transplantation. WATTS R. WEBB and HECTOR S. HOWARD, Jackson, Mississippi.

Experimental Study of the Effects of Transection of the Annulus by Combined Arterioventricular Incision for Direct Surgical Repair of Infundibular and Valvular Pulmonic Stenosis. ROYCE E. DAWSON, MICHAEL G. WEIDNER, JR., and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

Transbronchial Left Heart Catheterization; an Improved Technique and New Applications in Clinical Research. ANDREW G. MORROW and EUGENE BRAUNWALD, Bethesda, Maryland.

Pericardial Valve Grafts in the Surgical Therapy of Mitral Insufficiency. ALVIN A. BAKST and LEO LOEWE, Brooklyn.

Surgical Healing of the Atrioventricular Leaflets; an Experimental Study. WILLIAM S. LYONS and JOHN W. KIRKLIN, Rochester, Minnesota.

Tensile Strength of Myocardium. ERNST BECK and EDWARD J. BEATTIE, JR., Chicago.

The Effects of Cardiac Bypass on Ventricular Function; with Comments on the Design of Ventricular Incisions. GEORGE R. STIRLING, Minneapolis.

The Surgical Anatomy of the Cardiac Septa. JORGE A. RODRIGUEZ, Jackson, Mississippi.

Monday, 1:30–5:00 p.m., Convention Hall, Room B.

CANCER

The Cytologic Demonstration of Malignant Cells in Surgical Patients. STUART ROBERTS, ALVIN WATNE, ELIZABETH MCGREW, RUTH MCGRATH, and WARREN H. COLE, Chicago.

Incidence of Tumor Cells in Blood and Peritoneal Fluid in Patients with Cancer. GEORGE E. MOORE, ALFRED D. KATZ, AVERY A. SANDBERG, and EUGENE M. BURKE, Buffalo.

Selective Perfusion of Isolated Viscera with Chemotherapeutic Agents Using an Extracorporeal Circuit. ROBERT F. RYAN, EDWARD T. KREMENTZ, and OSCAR CREECH, JR., New Orleans.

Role of Cellular Dosage on "Takes" Following Inoculation of Walker 256 Tumor Cells in the Rat. ROBERT J. OVERSTREET and GERALD O. MCDONALD, Chicago.

Limiting Factors in the Prophylaxis of Cancer by Chemotherapeutic Methods. CORNELIUS T. MCDONALD, JOHN S. HOWIE, and COLIN G. THOMAS, JR., Chapel Hill, North Carolina.

Effects on the Liver of the Intraportal Administration of Nitrogen Mustard in the Rabbit. WILLIAM J. GRABER, III, HARRY J. MORESI, JR., and EDWARD T. KREMENTZ, New Orleans.

Toxicity of Nitrogen Mustard in Relation to Operations. FRANCISCO R. MORALES, Chicago.

Effect of DDD on Postcastrational Adrenal Tumors in Mice. CARLOS MARTINEZ and BERNARD ZIMMERMANN, Minneapolis.

Inhibition of Hepatoma Growth by an Organ-Specific Embryonic Inhibitor. KENNETH C. WILLIAMS and TOM D. NORMAN, Jackson, Mississippi.

The Growth of Human Tumors in Hamsters After Freezing Anoxia and Hibernation. WILLIAM S. FLETCHER and W. BRADFORD PATTERSON, Boston.

The Effect of Local Infiltration of a Heterologous Antiserum on Lymphoma Cutis in Man. J. T. GRACE, F. GOLLAN, W. L. TAYLOR, and ROBERT I. CARLSON, Cleveland.

Monday, 1:30–5:00 p.m., Convention Hall, Room C.

OLIGEMIC SHOCK

Alterations in Serum Glutamic Oxaloacetic Transaminase Activity Following Operations. W. L. CRAVER, G. JOHNSON, JR., and JOHN M. BEAL, New York.

Serum Properdin Titers in Surgical Patients. JERREL W. BENSON and WILLIAM D. HOLDEN, Cleveland.

The Continuous Measurement of Blood Volume. ADRIAN KANTROWITZ, NORTON RITZ, JOHN F. MARION, DAVID F. REARICK, and ALFRED HURWITZ, Brooklyn.

A Method for the Continuous Electron Measurement of Operative Blood Loss. HARRY H. LEVEEN, Brooklyn.

The Physiologic Effects of Acute Anemia Produced by the Replacement of Serial Hemorrhages with Dextran, Plasma, and Whole Blood. WARREN WISE, LOUIS R. HEAD, and J. GARROTT ALLEN, Chicago.

The Effect of Norepinephrine on Survival in Experimental Acute Hemorrhagic Hypotension. A. STEPHEN CLOSE, ROSS C. KORY, JOHN A. WAGNER, and RALPH A. KLOEHN, JR., Wood, Wisconsin.

Plasma Sequestration in Endotoxin Shock. J. B. AUST, J. JOHNSON, and M. B. VISSCHER, Minneapolis.

Experimental Hemorrhagic Shock; the Effect of Hypothermia Induced After Rapid Arterial Hemorrhage in the Dog. THOMAS FERGUSON, JOHN WILSON, DALTON JENKINS, and HENRY SWAN, Denver.

The Effect of Antibiotics and Visceral Hypothermia in the Prevention of Ischemic Shock. S. J. LEBRIE, W. M. PARKINS, and H. M. VARS, Philadelphia.

Therapeutic Effects of Chlorpromazine on Experimental Hemorrhagic Shock. F. G. INGLIS, L. G. HAMPSON, and FRASER N. GURD, Montreal.

Tuesday, 8:30 a.m.–12:00 noon, Convention Hall, Room A.

PLASTIC SURGERY

Revascularization of Skin Autografts Following Therapeutic Irradiation. SHELDON O. BURMAN, Chapel Hill, North Carolina.

Augmentation of Circulation in Pedicled Tissues. RICHARD B. STARK and CLAYTON DE HAAN, New York.

Experimental Studies on the Healing of Radiant Energy Thermal Burns. J. RAYMOND HINSHAW and FRED W. PAYNE, Rochester, New York.

The Marginal Mechanism of Wound Contraction. HERMES G. GRILLO, GEORGE T. WATTS, and JEROME GROSS, Boston.

Studies on Acquired Tolerance to Homografts and Heterografts. RICHARD H. EGDAHL and RICHARD L. VARGO, Minneapolis.

Studies on Reversibility of Homograft Rejection. MILTON T. EDGERTON and PATRICIA J. EDGERTON, Baltimore.

Transplantation of Embryonic Mouse Hearts; Observation of Pulsation as a Criterion of the Survival Time of Homografts. HERBERT CONWAY and JOHN E. SHANNON, JR., Boston.

Tissue Reactions to Cross Grafts Following Exchange Transfusions of Blood. RICHARD H. ANDRESEN, CLARENCE W. MONROE, GEORGE M. HASS, and DOROTHY A. MADDEN, Chicago.

Composition and Execution in Surgical Photography; Results of Experimentation. JOHN R. DICKSON, Jackson, Mississippi.

Physiology of the Palatopharyngeal Area Following Posterior Pharyngeal Flap Palatorrhaphy. RICHARD C. WEBSTER and RICHARD J. COFFEY, Brookline, Massachusetts.

Tuesday, 8:30 a.m.–12:00 noon, Convention Hall, Room B.

PANCREATITIS AND OTHER SUBJECTS

Hemolytic Aspects of Acute Pancreatitis. FRANK BERRIDGE, Columbus, Ohio.

Pathogenesis of Acute Pancreatitis; the Relationship Between Edematous Pancreatitis and Necrotizing Pancreatitis. PAUL NEMIR, JR., and D. L. DRABKIN, Philadelphia.

Serum Trypsin; a New Diagnostic Test for Pancreatic Disease. GEORGE L. NARDI, Boston.

A Study of the Relationships Between Alcoholic Intoxication, Vomiting, and Acute Hemorrhagic Pancreatitis. ANTONIO BOBA, ARTHUR A. STEIN, HOSHIHIKO NAKAMURA, and SAMUEL R. POWERS, Albany, New York.

The Clinical Picture of the Sequential Development of Acute Hemorrhagic Pancreatitis in the Dog. ROBERT B. PFEFFER, ORKAN STASIOR, and J. WILLIAM HINTON, New York.

The Effect of Propylthiouracil on Acute Hemorrhagic Pancreatitis in Dogs. ROBERT E. PAULETTE, THOMAS W. CHALLIS, L. CORSAN REID, and J. WILLIAM HINTON, New York.

Excretion of Antibiotics and Other Studies in a Patient with an External Pancreatic Fistula. FREDERICK W. PRESTON, BERNARD C. GERBER, and MILTON SILVERMAN, Chicago.

Effects of Glucagon Following Total Pancreatectomy in Man. FREDERICK J. NEHER and BERNARD ZIMMERMANN, Minneapolis.

Function of the Regenerating Thyroid Gland. F. L. FONG, N. KALANT, and M. M. HOFFMAN, Montreal.

Further Observations on Pharmacologic Reactions of the Bladder. JACK LAPIDES, NORMAN B. HODGSON, and ROBERT E. BOYD, Ann Arbor, Michigan.

Tuesday, 8:30 a.m.–12:00 noon, Convention Hall, Room C.

PHYSIOLOGY AND METABOLISM OF THE HEART

The Relation of the Specific Tissue to the Common Muscle in the Heart. PETER A. DEL MISSIER, ALFRED A. ANGRIST, L. CORSAN REID, and J. WILLIAM HINTON, New York.

Cardiac Metabolism Under Conditions Associated with Open-Heart Operations—I, Coronary Sinus Flow and Myocardial Oxygen Consumption. V. L. WILLMAN, E. C. NEVILLE, and C. ROLLINS HANLON, St. Louis.

Carbohydrate Metabolism of the Isolated Perfused Dog Heart. JOHN E. JESSEPH, PAUL W. HERRON, ROY R. VETTO, and K. ALVIN MERENDINO, Seattle.

Restoration of Function in the Refrigerated Heart. WATTS R. WEBB and HECTOR S. HOWARD, Jackson, Mississippi.

Myocardial Metabolism During Hypothermia with Caval Occlusion and Low Flow Coronary Perfusion. J. A. DEWEESE, T. I. JONES, and EARLE B. MAHONEY, Rochester, New York.

Cardiac Arrhythmias and Ventricular Fibrillation Resulting from Rapid Reversal of Hypercarbia. ARCHER S. GORDON, PHILIP W. ANDREWS, and EDWARD J. BEATTIE, JR., Chicago.

Influence of Cardiac Output, Aortic Pressure, and Heart Rate on Myocardial O^2 Utilization. G. H. WELCH, S. J. SARNOFF, E. BRAUNWALD, W. N. STAINSBY, R. B. CASE, and R. MACRUZ, Bethesda, Maryland.

Analysis of Acid-Base Derangements Related to Total Cardiac Bypass. ROBERT G. PONTIUS, ELTON WATKINS, JR., BRUCE S. MANHEIM, ROBERT ALLEN, LESTER R. SAUVAGE, and ROBERT E. GROSS, Boston.

Myocardial Contractile Force as a Measure of Cardiac Function During Cardiopulmonary Bypass. W. H. LEE, JR., J. D. ASHMORE, T. D. DARBY, and EDWARD F. PARKER, Charleston, South Carolina.

Physiologic Changes and Survival Rate in Prolonged Bubble Oxygenation Perfusion with Complete Cardiopulmonary Bypass. WILLIAM A. REED and C. FREDERICK KITTLE, Kansas City, Kansas.

Transplantation of the Homologous Canine Heart. SALEM F. SAYEGH and OSCAR CREECH, JR., New Orleans.

Tuesday, 1:30–5:00 p.m., Convention Hall, Room B.

FLUIDS AND ELECTROLYTES

Biochemical Alterations Resulting from Various Intravenous Regimens Given Preoperatively and Postoperatively—I, Metabolic Balance Studies. HARVEY KRIEGER, WILLIAM E. ABBOTT, STANLEY LEVEY, HARRY S. SOROFF, ALVIN H. HARRIS, and WILLIAM D. HOLDEN, Cleveland.

Transfer of Water (Deuterium Oxide) Across the Pleural and Peritoneal Membranes. JOHN M. HOWARD, MILTON F. BRYANT, and CHESTER W. DRAWHORN, Atlanta, Georgia.

Postoperative Saline Therapy. D. MILLAR BELL, Chicago.

The Paradoxical Relationship of Sodium Chloride to Water Balance in the Early Postsurgical Period. JAMES H. CASEY, FREDERICK J. NEHER, and BERNARD ZIMMERMANN, Minneapolis.

Alterations in Body Composition with Preparation of Cardiac Patients for Surgery. K. H. Olesen, H. V. Parker, and Francis D. Moore, Boston.

Nutriodialysis; a New Method for Administration of Glucose and Amino Acids. Dean T. Gettler and Paul R. Schloerb, Kansas City, Kansas.

Blood Ammonium Levels After Infusions of Protein Hydrolysates. Mary Ann Payne, Nathan Brot, George Johnson, Jr., and John M. Beal, New York.

Relationship of Temperature to Time in Establishing Safety of Liquid Stored Plasma. Wynn A. Sayman and J. Garrott Allen, Chicago.

The Intravenous Administration of Glycerol to Humans. A. Sloviter, Charles R. Smart, and N. Henry Moss, Philadelphia.

A Summary of Clinical Experience with Intravenous Fat Emulsions. Harrison H. Shoulders, Jr. and H. C. Meng, Nashville, Tennessee.

A Stable Fat Emulsion for Clinical Use. E. H. Storer and Joe Campbell, Memphis, Tennessee.

Tuesday, 1:30–5:00 p.m., Convention Hall, Room C.

HEART AND CORONARY CIRCULATION

Experimental Studies on the Cardiac Lymphatics. Philip R. Allison and David C. Sabiston, Jr., Baltimore.

The Distribution of the Occlusive Process in Coronary Arteriosclerosis; a Postmortem Roentgenologic Study. Richard T. McDonald, John Sieracki, and D. Emerick Szilagyi, Detroit.

Evaluation of Contrast Media Employed for Aortic and Coronary Visualization. O. Hase and Ralph A. Deterling, Jr., New York.

Contribution of the Altered Internal Mammary Circulation to the Coronary Blood Flow. James C. Griffin, Jr., James D. Hardy, and M. Don Turner, Jackson, Mississippi.

Coronary Arteriography in the Adult Human Patient. Alan Thal, Richard Lester, and Stephen Richards, Minneapolis.

An Artificial Electronic Conduction System for Management of Experimental Heart Block. Judah M. Folkman and Elton Watkins, Jr., Boston.

Experimental Coronary Artery Occlusion; Ventricular Fibrillation and Survival as Affected by Selected Drugs and Ionic Alterations. William T. Williams, Albert L. Meena, and M. Don Turner, Jackson, Mississippi.

Evaluation of Internal Mammary Artery Ligation for Relief of Angina Pectoris. Charles R. Blair, Robert F. Roth, and Harold A. Zintel, New York.

Extension of the Limits of Cardiac Viability with Total Coronary Occlusion. Watts R. Webb and Hector S. Howard, Jackson, Mississippi.

Support of Patients with Acute Massive Myocardial Infarction with the Heart-Lung Machine. Jackson H. Stuckey, Melvin M. Newman, Clarence Dennis, Elliot H. Berg, Stanley E. Goodman, Charles C. Fries, Karl E. Karlson, Margaret Blumenfeld, Stanley W. Weitzner, Lee S. Binder, and Arnold Winston, Brooklyn.

Aortic Arch Resection Using a Mechanical Shunt; a Study of Safety Factors. Keith D. J. Vowles, Cecil M. Couves, and John M. Howard, Atlanta, Georgia.

Wednesday, 8:30 a.m.–12:00 noon, Convention Hall, Room A.

UROLOGY

Clinical Studies of Excretion and Localization of Diethylstilbestrol Diphosphate Labelled with Radioactive Phosphorus (P^{32}). Lester Persky, Jack S. Krohmer, and John P. Storaasli, Cleveland.

Effect of Increasing Pressure in the Renal Veins and of Obstruction to Renal Lymphatic Outflow upon Urinary Protein Concentration. Robert Klaus, James Shallow, and John J. Murphy, Philadelphia.

The Degree of Recovery of Renal Function After Release of Ureteral Obstruction of 7 Days in Dogs. Walter S. Kerr, Jr., Boston.

Effect of Increasing Pressure in the Bladder and in the Colon upon the Rate of Formation of Urine and Renal Lymph. M. K. Myint and John J. Murphy, Philadelphia.

An Evaluation of the Role of the Artificial Kidney in Treatment of Acute Renal Failure. J. S. Ansell, M. P. Reiser, Robert Abernathy, Dennis Kane, Harris Hyman, III, and Arnold Colodny, Minneapolis.

Renal Transplantation; Use of a Perfusion Pump for Preservation of Donor Kidney. Nathan P. Couch and Joseph E. Murray, Boston.

The Results of Isolated and In Situ Renal Perfusions. Oliver L. Bowens, Jr., Morris Fried, and Harry H. Miller, Boston.

Studies on Experimental Production and Dissolution of Renal Calcinosis. P. N. Kataria, W. F. Lingard, and Grant Reid, Montreal.

Observations on the Excretion of Factors Concerned with Urinary Calculi After the Administration of Acetylsalicylic Acid and Glucuronalactone. FRANK C. HAMM, S. R. WEINBERG, LEO KESNER, and PHILIP LEWIS, Brooklyn.

The Protective Effect of Local Kidney Cooling on Total Renal Ischemia. RICHARD WALDORF, JOHN WELSH, and PAUL R. SCHLOERB, Kansas City, Kansas.

Artificial Bladder in Man from Segment of Stomach. EDWIN S. SINAIKO, Chicago.

Uretero-Ileo-Sigmoidostomy. PERRY B. HUDSON, New York.

Experiments with Intussuscepted Ileal Valve in Ureteral Substitution. WILLARD E. GOODWIN and RODERICK D. TURNER, Los Angeles.

Experimental Temporary Urinary Diversion to an Isolated Ileal Bladder. JAMES R. JUDE and WILLIAM J. PIEPER, Bethesda, Maryland.

Cystoplasty to Increase Bladder Capacity; Experimental and Clinical Use of Isolated "Patches" and Loops of Small and Large Bowel to Increase Urinary Bladder Capacity. CHESTER C. WINTER and WILLARD E. GOODWIN, Los Angeles.

Evaluation of a New Spiral Technique for Correction of Defects of the Ureter. J. L. ALVIS, J. WIENER, and TOM D. NORMAN, Jackson, Mississippi.

Wednesday, 8:30 a.m.–12:00 noon, Convention Hall, Room B.

LIVER AND BILIARY TRACT

Effect of Hepatectomy on the Protein Components of the Plasma. JAMES G. STEPHENS, RICHARD A. BAHN, J. FOPIANO, and WORTHINGTON G. SCHENCK, JR., Buffalo.

Effects of Intra-abdominal Pressure on the Portal Vein Pressure. JOHN R. DERRICK, JACK A. THOMPSON, and JOHN M. HOWARD, Atlanta, Georgia.

A New Method for Measurement of Hepatic Blood Flow. GEORGE J. HAUPT, WALTER F. BALLINGER, II, and JOHN H. GIBBON, JR., Philadelphia.

Demonstration of Impaired Blood Flow Through the Liver Following Circulation Stasis. M. DON TURNER, WILLIAM O. BARNETT, and JAMES C. GRIFFIN, JR., Jackson, Mississippi.

The Amelioration of Experimental Ascites by Hepatopexy. ANDREW A. GAGE, ROBERT W. MCGRATH, MICHAEL J. GIANTURCO, and CARLOS G. SANTORO, Buffalo.

Studies on Lipid Metabolism in Dogs with Altered Biliary Physiology. STEPHEN G. ECONOMOU, BEVERLY J. TEWS, C. BRUCE TAYLOR, and G. E. COX, Chicago.

Studies on the Production of Biliary Concrements with 3, Beta-Cholestanol in Laboratory Animals. EUGENE G. CAIRA, STANELY C. SKORYNA, ALEXANDER C. RITCHIE, and DONALD R. WEBSTER, Montreal.

Production of Bile Duct Stones by Experimental Stricture of the Terminal Common Bile Duct. KAMIL IMAMOGLU and EARL G. YNEHIRO, Minneapolis.

Intrahepatic Cholangiography for the Regular Visualization of the Biliary Tree. ALEXANDER MARGULIS, STEPHEN RICHARDS, and ALAN THAL, Minneapolis.

Studies on the Ammonia Tolerance Curve in Dogs with Portacaval Shunts. ROBERT S. LEVINE and STANLEY P. RIGLER, Chicago.

Tolerance of Eviscerectomized Dogs to Exogenous Ammonium Salts. WALTER LAWRENCE, JR., ARTHUR E. SCHWARTZ, KATHLEEN E. ROBERTS, and HENRY T. RANDALL, New York.

Wednesday, 8:30 a.m.–12:00 noon, Convention Hall, Room C.

OXYGENATION, HYPOTHERMIA, BYPASS PROCEDURES, AND VALVULAR SURGERY

Observations on Controlled Cardiac Asystole in Intact Dogs. ROBERT J. SCHRAMEL, ERSKINE ROSS, R. D. MORTON, and OSCAR CREECH, JR., New Orleans.

Comparison of the Response to Potassium Cardiac Arrest of Hearts Under Hypothermic and Normothermic Conditions. DON E. MOREHEAD, MARIANO LOPEZ-BELIO, GILBERT W. DOUGLAS, and ORMAND C. JULIAN, Chicago.

Localized Cardiac Hypothermia as an Adjunct to Elective Cardiac Arrest. FREDERICK S. CROSS, R. D. JONES, and R. M. BERNE, Cleveland.

Application of an Artificial Pacemaker and Myocardial Wiring to Control Complete Atrioventricular Dissociation Following Intracardiac Surgery. WILLIAM L. WEIRICH, Minneapolis.

Total Cardiopulmonary Bypass Using Experimental Intravenous Oxygenation. JOHN E. CONNOLLY, VICTOR RICHARDS, EDMUND J. HARRIS, and SHAUN HOLMAN, San Francisco.

Experimental and Clinical Evidence of Air Embolism with the Bubble Oxygenator; Comparison with the Gibbon Oxygenator. JAMES V. MALONEY, JR., S. A. MARABLE, K. J. SCHMUTZER, G. DIESH, and WILLIAM P. LONGMIRE, JR., Los Angeles.

The Importance of Porosity in Prosthetic Arterial Grafts. W. STERLING EDWARDS, Birmingham, Alabama.

The Use of Externally-Supported Aortic Homografts in the Superior Vena Cava. DAVID M. ENERSON, Syracuse, New York, and HARRIS B. SHUMACKER, JR., Indianapolis.

A Simple Nonsuture Technique for Rapid Vascular Anastomosis. JORGE A. RODRIGUEZ and JESSE L. WOFFORD, Jackson, Mississippi.

Total Replacement of the Mitral Valve. ELLIOT H. BERG, STANLEY E. GOODMAN, JACKSON H. STUCKEY, and MELVIN M. NEWMAN, New York.

Transarterial Pulmonary Valvulotomy in the Functioning Heart; a Digital and Instrumental Approach Through a Diverticulum. WILLIAM W. L. GLENN, HERBERT S. HARNED, JR., and ALLAN V. N. GOODYER, New Haven, Connecticut.

An Experimental Surgical Treatment for Aortic Insufficiency. BERNARDO CASTRO-VILLAGRANA, ALAIN SISTERON, and MICHAEL E. DEBAKEY, Houston, Texas.

Wednesday, 1:30–5:00 p.m., Convention Hall, Room B.

WOUND HEALING AND SURGICAL INFECTIONS

Alterations in Body Composition with Preparation of Cardiac Patients for Surgery. K. H. OLESEN, H. V. PARKER, and FRANCIS D. MOORE, Boston.

Chemical and Metabolic Studies During Wound Healing. PHILLIP E. LEAR, New York.

Hormonal Influence on Healing Wounds; the Effect of Adrenalectomy and Cortisone on the Quantity and Collagen Content of Granulation Tissue. LOUIS N. PERNOKAS, LEON C. EDWARDS, and J. ENGLEBERT DUNPHY, Boston.

Effect of Nitrogen Mustard and Thiotepa on Wound Healing. J. HAROLD CONN, SAMUEL M. LEB, and JAMES D. HARDY, Jackson, Mississippi.

Effects of Triethylenemelamine on Wound Healing. EDWARD T. KREMENTZ, W. R. GIDDENS, and W. L. CHAPMAN, New Orleans.

The Healing of Human Wounds; In Vivo Studies. HAROLD B. HALEY and MARTIN B. WILLIAMSON, Chicago.

Vascular Basis of Tendon Repair. ERLE E. PEACOCK, JR., Chapel Hill, North Carolina.

Effect of Hypothermia on Experimental Infection. R. S. WOTKYNS, H. HIROSI, and BEN EISEMAN, Denver.

The Effects of Hypothermia on Infection; an Experimental Study. FRED SANDERS, E. STANLEY CRAWFORD, and MICHAEL E. DEBAKEY, Houston, Texas.

Hospital Infections with Antibiotic-Resistant Staphylococci; Bacteriologic and Clinical Experiences and Methods of Control. H. TAYLOR CASWELL, W. EMORY BURNETT, and KENNETH E. SCHRECK, Philadelphia.

Ethylene Oxide Sterilization; a New Method. JOHN H. DAVIS, J. S. WOLKOFF, and J. R. LEONARDS, Cleveland.

Standardization Test for Sutures. J. W. BLUNT, JR., Cleveland.

Wednesday, 1:30–5:00 p.m., Convention Hall, Room C.

ORTHOPEDIC SURGERY

The Local Effect upon Bone, Cartilage, and Joint Tissues of the Polymerization of Methyl Methacrylate in Situ. HARRY T. GLASER, Buffalo.

Transplantable Osteogenic Sarcoma of the Mouse Exposed to Vitamin A Intoxication and Vitamin D Deficiency. EDWIN G. BOVILL, JR., San Francisco.

Experimental Production of Heterotopic Ossification by Nonviable Materials of Biologic Origin. JOHN M. GOIN, JOHN C. CLARKE, JOHN Q. OWSLEY, JR., and JACKSON T. CRANE, San Francisco.

Comparison of the Effects of Cortisone and Nilevar (17-Ethyl-19 Nortestosterone) on the Uptake of Radiosulfur in the Fractured Humerus in the Rat. K. KOWALEWSKI and R. K. LYON, Edmonton, Alberta, Canada.

The Effect of Total Body Irradiation on Bone Transplants in Parabiosed Animals. W. F. ENNEKING, AVRUM GRATCH, and HEBER ETHRIDGE, Jackson, Mississippi.

A Study of Back Pain; Use of Progressive Resistive Exercises as a Primary Mode of Treatment. CARROLL B. LARSON, Iowa City.

The Effect of Previous Trauma on Experimental Epiphysiolysis in Rats. J. WILLIAM HILLMAN and WILLIAM HUNTER, Nashville, Tennessee.

The Effect of the Addition of Plaster of Paris to Autogenous and Homogenous Bone Grafts in Dogs. LEONARD F. PELTIER and DUANE ORN, Kansas City, Kansas.

Bone Transplantation in Dogs Using Beta Propiolactone as a Sterilizing Agent. D. A. BAIRD, G. H. RYAN, and C. C. FERGUSON, Winnipeg, Ontario, Canada.

Spectrophotometric Curves of the Urine in Patients Who Undergo Operations on the Bones and Joints. JAMES A. NICHOLAS, PHILIP D. WILSON, FRANCO FIORESE, and CHARLES J. UMBERGER, New York.

Thursday, 8:30 a.m.–12:00 noon, Convention Hall, Room B.

GASTROINTESTINAL TRACT

Alterations in Renal Hemodynamics in Patients with the "Dumping Syndrome." GEORGE C. MORRIS, JR., and GEORGE L. JORDAN, JR., Houston.

Dumping Syndrome; Reproducibility of the Clinical and Laboratory Phenomena in Normal and Gastrectomized Patients. M. G. WEIDNER, JR., A. G. BOND, W. G. GOBBEL, H. J. SHULL, and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

Absorption of Radioactive Iron After Gastrectomy. DWIGHT H. MURRAY, JR., JOHN S. NAJARIAN, C. D. BUSTER, KENNETH G. SCOTT, HAROLD A. HARPER, and HORACE J. MCCORKLE, San Francisco.

Studies of Peptic Activity of Human Gastric Juice Using Tissue Culture Methods. WILLIAM FELLER and KAMIL IMAMOGLU, Minneapolis.

The Inhibitory Role of the Pyloric Antrum on the Cephalic Phase of Gastric Acid Secretion in Dogs. DAVID STATE and LEON MORGENSTERN, Los Angeles.

The Efficacy of Removal of Peritoneal Fluid in Experimental Strangulated Intestinal Obstruction. WILLIAM O. BARNETT and JAMES D. HARDY, Jackson, Mississippi.

Experimental Cancer of the Gastrointestinal Tract. JOSEPH G. FORTNER, New York.

Uptake of 2-C-14 Labelled Tryptophan by Malignant Carcinoid Tumor. JACK W. COLE and LEROY MATTHEWS, Cleveland.

The Action of Styrol Quinoline Compounds Against Walker 256 Tumor. F. A. DEPEYSTER, P. Y. CHAN, and WARREN H. COLE, Chicago.

Clorpactin, a Surgical Adjunct. MARVIN L. GLIEDMAN, ROALD N. GRANT, CHARLES ROGERS, and KARL E. KARLSON, New York.

Thursday, 8:30 a.m.–12:00 noon, Convention Hall, Room C.

EXTRACORPOREAL CIRCUITS, PULMONARY PHYSIOLOGY, AND ANESTHESIA

Digital Plethysmography in Evaluation of Surgery of Degenerative Arterial Disease. I. LYNN EVANS, E. STANLEY CRAWFORD, and MICHAEL E. DEBAKEY, Houston, Texas.

An Experimental Study Indicating the Relationship Between Blood Volume and Available Venous Return During Extracorporeal Circulation. PAUL W. HERRON, JOHN E. JESSEPH, and K. ALVIN MERENDINO, Seattle.

The Effect of a Nonoxygenated Coronaropulmonary Flow in Certain Phases of Cardiac Bypass. MARIANO LOPEZ-BELIO, HUNG H. SU, and ORMAND C. JULIAN, Chicago.

Beneficial Effects of Inferior Vena Caval Occlusion when Thoracic Aorta Is Occluded. W. G. GOBBEL, JR., J. B. DALTON, ROBERT I. CARLSON, W. L. TAYLOR, and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

Influence of Position Change on Blood Flow to Separate Lungs; In Vivo Studies. ALBERT MOWLEM and GILBERT S. CAMPBELL, Minneapolis.

The Reversibility of Chronic Atelectasis. JOHN R. BENFIELD, ROBERT W. HARRISON, JOHN F. PERKINS, JR., GERALD P. HERMAN, ED TUT LONG, and WILLIAM E. ADAMS, Chicago.

Superficial Venous Engorgement During Anesthesia. RICHARD C. MCPHERSON, JAY J. JACOBY, and ERIC OGDEN, Columbus, Ohio.

Anesthetic Convulsions; the Role of Ether and Hyperthermia in Their Production. GUY OWENS, ROYCE E. DAWSON, and H. WILLIAM SCOTT, JR., Nashville, Tennessee.

The Importance of Measuring Ventilation During Steady States. THOMAS F. NEALON, JR., JOYCE E. PRICE, and JOHN H. GIBBON, JR., Philadelphia.

Bronchial Artery, Left Auricular Blood Flow; Its Relation to Pulmonary Damage in Extracorporeal Circulation. JAMES B. LITTLEFIELD, PHYLLIS R. INGRAM, FRANK S. BLANTON, JR., J. FRANCIS DAMMANN, JR., and WILLIAM H. MULLER, JR., Charlottesville, Virginia.

The Prevention of Alveolar Air Leaks Following Pulmonary Resection. JAMES R. CANTRELL and GEORGE H. WELCH, JR., Baltimore.

Respiratory Paralysis Following Pulmonary Denervation. HECTOR S. HOWARD and WATTS R. WEBB, Jackson, Mississippi.

Thursday, 8:30 a.m.–12:00 noon, Trimble Hall, Claridge.

NEUROLOGIC SURGERY

The Use of Lyophilized Homologous Dura Mater in Neurosurgery. W. EUGENE STERN, Los Angeles.

A Method for the Reinforcement of Intracranial Aneurysms with Adherent Plastics. BERTRAM SELVERSTONE and NORMAN RONIS, Boston.

Blood Loss in Intracranial Operations as Determined by Radioactive Chromium (Cr^{51}) Tagged Red Blood Cells and Iodinated Human Serum Albumin. EDMUND A. SMOLIK, FRANCIS P. NASH, RAYMOND O. MUETHER, and WILFRED KONNEKER, St. Louis.

Cerebral Blood Flow During Extracorporeal Circulation. OSCAR CREECH, JR., EMMANUEL BRESLER, ALBERT HYMAN, and ROBERT J. SCHRAMEL, New Orleans.

Neurosurgical Lesions Found in a Pilot Study of "Stroke Patients." D. W. LINDNER, J. E. WEBSTER, and E. S. GURDJIAN, Detroit.

Brain Tumor Localization with a New Microdetector. BERTRAM SELVERSTONE and CHARLES V. ROBINSON, Boston.

Absorption Potentiality of the Epidural Spaces. FRANCIS ENOMOTO and O. HUGH FULCHER, Washington, D. C.

Simple Methods of Treating Communicating Hydrocephalus in Infants and Children. O. HUGH FULCHER and FRANCIS ENOMOTO, Washington, D. C.

Experimental Occlusion of Dural Sinuses. GUY OWENS, GRAY STAHLMAN, JOE CAPPS, and ARNOLD MEIROWSKY, Nashville, Tennessee.

A New Simple Technique for Pallidotomy. GEORGE W. SMITH, Augusta, Georgia.

Experimental Production of Local Cerebral Edema by an Expanding Intracerebral Mass. MICHAEL P. SPERL, JR., HENDRIK J. SVIEN, NORMAN P. GOLDSTEIN, JAMES W. KERNOHAN, and JOHN H. GRINDLAY, Rochester, Minnesota.

Blood Pressure Alterations During Temporal Lobe Seizures. O. J. ANDY, R. McC. CHINN, and P. BONN, Jackson, Mississippi.

Thursday, 1:30–3:00 p.m., Trimble Hall, Claridge.

NEUROLOGIC SURGERY

Axonal Bridging of Millipore Protected Gaps in the Transected Feline Spinal Cord. JAMES B. CAMPBELL, C. ANDREW L. BASSETT, JAKOB HUSBY, and CHARLES R. NOBACK, New York.

The Operative Method and Physiologic Consequences of Total Hemispherectomy in the Monkey. ROBERT J. WHITE, LEON H. SCHREINER, ROBERT A. HUGHES, COLLINS S. MACCARTY, and JOHN H. GRINDLAY, Rochester, Minnesota.

Cerebral Oxygen Tension Changes in Macaca Mulatta Under Hypothermia and Carotid Occlusion. GEORGE M. AUSTIN and A. SAYEN, Portland, Oregon.

Angiographic Study of Internal Carotid Bifurcation. O. J. ANDY and JAMES S. BROWNE, Jackson, Mississippi.

Use of Intracarotid Arterial Procaine During Cranial Arteriography. ARTHUR B. KING, WILLIAM F. BREHM, JOHN B. COUGHLIN, and JACK A. YOUNG, Sayre, Pennsylvania.

Spontaneous Subarachnoid Hemorrhage, Expectations of Nonsurgical Treatment. JOHN P. GALLAGHER and FRANCIS T. ENOMOTO, Washington, D. C.

Effect of Hippocampal System After Discharges upon Learned Behavior. O. J. ANDY, R. McC. CHINN, and P. BONN, Jackson, Mississippi.

Thursday, 1:30–3:00 p.m., Ballroom, Shelburne.

GYNECOLOGY AND OBSTETRICS

17–21 Hydroxycorticosteroids in Labor and Delivery. LEE L. FARRIS, M. DON TURNER, JAMES D. HARDY, and MICHAEL NEWTON, Jackson, Mississippi.

Inactivation of Antidiuretic Activity of Vasopressin During Pregnancy. JAMES M. EGLIN, JR. and ANDREW G. JESSIMAN, Boston.

The Immediate Postpartum Cervix; a Colposcopic Study. WARREN R. LANG and PAUL ZIMSKIND, Philadelphia.

Effect of Hypophysectomy on FSH Levels and Vaginal Smear Cornification. HANNA KLAUS, Boston.

Survival of Homografts Within Millipore Filter Chambers in the Rat. H. CASTELLANOS and SOMERS H. STURGIS, Boston.

The Changes in the Serum Proteins and Lipoproteins of Patients Experiencing a Remission from Ovarian Carcinoma Induced by Thiotepa. BERNARD J. MILLER and DAVID M. FARRELL, Philadelphia.